AD-A100 099 ARMY ENGINEER DISTRICT NEW ORLEANS LA F/G 13/2

COOPER LAKE AND CHANNELS, TEXAS.(U)

APR 77

UNCLASSIFIED NL

1 of 5

AD A100099

AD A100099

LEVEL II

D 9

FINAL ENVIRONMENTAL STATEMENT.

6

COOPER LAKE AND CHANNELS, TEXAS.

11 APR[redacted]77

12 450

U.S. ARMY ENGINEER DISTRICT
NEW ORLEANS
LOUISIANA

COOPER LAKE AND CHANNELS, TEXAS

BASIC ECONOMIC DATA EXTRACTED FROM US ARMY CORPS OF ENGINEERS ALTERNATIVE PLAN STUDIES SUMMARY REPORT DATED MARCH 1975 AND FROM PRELIMINARY DATA DEVELOPED FOR PREPARATION OF THE EIS. ADDITIONAL INFORMATION AVAILABLE AT US ARMY ENGINEER DISTRICT, POST OFFICE BOX 60267, NEW ORLEANS, LOUISIANA 70160.

SUMMARY OF ECONOMIC ANALYSES OF THE SELECTED PLAN
(July 1974 Price Level)

First Cost	Average Annual Cost	Average Annual Benefits	Benefit Cost Ratio
$67,764,000	$3,178,100	$4,727,500	1.5

ITEMIZED AVERAGE ANNUAL BENEFITS
(July 1974 Price Level)

Flood Control		$1,292,000
Employment		255,000
Fish, Wildlife, and General Recreation		1,452,500
Water Supply		1,728,000
	Total	$4,727,500

NONQUANTIFIABLE ENVIRONMENTAL BENEFITS AND COSTS HAVE NOT BEEN REFLECTED IN BENEFIT-TO-COST DETERMINATION TO THE FOLLOWING EXTENT:

Costs: The deleterious effects to water quality and the elimination or reduction in populations of plankton, benthic fauna, terrestrial invertebrates, amphibians, and reptiles. Deterioration of air and noise levels during construction and maintenance. Adverse esthetic impacts of the channel and levees. Inundation of some 90 archeological sites which have been tested to the extent necessary to provide minimum mitigation.

Benefits: Public use of approximately 6,000 acres of reservoir right-of-way, with a potential for sizeable recreation benefits if properly managed. Recreation benefits, primarily sport fishing, from the riverside borrow ditches resulting from borrow excavation for construction of levees. Benefits of the tailwaters to fishery resources. Positive effects on major tributaries immediately above the reservoir, especially from migratory fishes moving into tributaries to spawn.

A

S U M M A R Y

COOPER LAKE AND CHANNELS, TEXAS

( ) Draft (x) Final Environmental Statement

Responsible Office: Colonel Early J. Rush III, District Engineer
US Army Engineer District, New Orleans
Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160
(504) 865-1121

1. Name of Action: (x) Administrative ( ) Legislative

2. Description of Action: The selected plan is a coordinated effort to combine the most economical and desirable aspects of a multipurpose reservoir and levees to provide 30-year flood protection for the Sulphur River Basin in northeast Texas. The draft EIS plan, which included extensive channelization, received authorization for construction in 1955 and work began on the channel and levees feature shortly thereafter. In May 1971, the US District Court for the Eastern District of Texas, acting on a motion for preliminary injunction by the Texas Committee on Natural Resources, et al., halted further construction on the project until an environmental statement was filed with CEQ. Up to the time of injunction, levee and channel work upstream of the reservoir was 100 percent complete and work below the reservoir was approximately 50 percent complete. In June 1976, the draft environmental impact statement (EIS) was coordinated for review and on 31 July 1976, a public meeting was held to provide wider exposure and consideration of the statement. Based on the oral testimony given at the public meeting and the written statements of comment submitted during coordination, the decision was made to abandon most of the remaining channel feature of the plan presented in the draft EIS and to select the alternative, "Reservoir and Levees." Completion of the selected plan would require construction of the following features:

a. A multipurpose reservoir with a dam, spillway works, and spillway outflow channel on the South Sulphur River at mile 23.2.

b. The enlargement and/or extension of existing levees and the construction of new levees to provide flood protection from the damsite to just above State Highway No. 26 (US Highway No. 259).

c. The extension of an existing channel and the construction of a new channel where levee construction necessitates cutting off natural channel bends.

3. a. Environmental Impacts:

(1) Reservoir. The flood storage space in the approved reservoir will provide flood protection for 12,900 acres of land below the damsite. The flood storage space in Cooper Lake will also allow the conversion of 120,000 acre-feet of existing flood storage in Wright Patman Lake (formerly Lake Texarkana) to water supply. Cooper Lake will provide 273,000 acre-feet of storage space for municipal and industrial water supply. Participation in outdoor recreation activities by Sulphur River Basin residents has been quite limited in the past, due primarily to the lack of suitable areas and facilities. The reservoir and related recreation facilities will provide the needed resources and development for many types of outdoor recreation. The annual benefits in consumptive and nonconsumptive recreation will total nearly 923,000 man-days with a value in excess of $1.4 million. In addition the lake is capable of supporting an annual harvest of 417,600 pounds of commercial fish valued at nearly $50,000.

(2) Levees and channels. The levees feature of the selected plan will provide flood protection for 11,400 acres of land along the South Sulphur and Sulphur Rivers, for floods having a recurrence interval of once every 30 years. Construction of the essential channels will create 16 miles of oxbow cutoffs which are capable of supporting approximately 3,200 man-days of consumptive recreation and a harvest of approximately 3,400 pounds of commercial fish, with a total, combined annual value of $5,500. Modified areas, in the form of levees or disposal areas for excavated material from channel construction, should provide support habitat for species which normally inhabit bottomland hardwood areas.

b. Adverse Environmental Effects:

(1) Reservoir. Approximately 19,000 acres of terrestrial habitat will be permanently inundated by the lake. All of the faunal inhabitants will be forced to relocate or die. In addition, 21 miles of the South Sulphur River above the damsite will lose all characteristics which distinguish streams from lakes due to this inundation. Although an increase in the population of

sport and commercial fish is anticipated, in excess of 50 percent of the species occurring in the natural streams may be reduced or eliminated from the reservoir. In addition to losses directly attributable to project construction, induced clearing of 2,560 acres of bottomland hardwoods and 1,500 acres of semiwooded area would result in further adverse impact to the natural environment. Direct and indirect project induced annual losses in consumptive and nonconsumptive recreation total nearly 12,000 man-days with a value of about $27,000. The loss in potential for an annual harvest of 2,100 pounds of commercial stream fish valued at about $300 would result from inundation of the natural river. The loss in potential for an annual harvest of commercial furbearers valued at about $3,600 would result from losses in bottomland hardwood acreage. Reservoir construction will produce substantial air and noise pollution during the early phases of the project. Several roads and utility lines, and a number of graves must be relocated. Ninety archeological sites will be directly affected by construction of the reservoir; however, by the time construction is initiated, sufficient salvaging will have been accomplished to provide minimum mitigation of the loss of archeological resources in the Cooper Lake area.

(2) Levees and channels. Some 800 acres of land are required for construction of the levees and limited channels. Terrestrial fauna and flora will be eliminated from that area occupied by the channel, while disposal of dredged material and levee construction will permanently alter the immediate terrestrial ecosystem. Construction of the channels will result in the realinement of 16 miles of natural river with a resulting loss of riparian cover, increased current velocities, increased turbidity, and a reduction in habitat diversity for aquatic fauna. Of greater significance is the potential loss of 6,960 acres of bottomland hardwoods and 1,800 acres of semiwooded area to agricultural pursuits as a result of the flood protection provided by the levees. Direct and indirect project induced losses in consumptive and nonconsumptive recreation total nearly 9,000 man-days annually, with a value of nearly $20,000. The loss in potential for an annual harvest of 4,800 pounds of commercial fish valued at $720 would result from the channelization. The loss in potential for an annual harvest of commercial furbearers valued at about $2,700 would result from losses in bottomland hardwood acreage. Construction of the levees and channels will produce adverse air and noise impacts during construction, and a subsequent deterioration in water quality. Several bridges, pipelines, and powerlines will require relocation. This feature of the selected plan could adversely impact upon one archeological site; however, attempts will be made to avoid this site during construction.

4. Alternatives to the Proposed Action:

a. Structural

(1) Alternatives which would accomplish all of the objectives of the proposed action

(a) Reservoir and channel.

(b) Authorized reservoir, levees, and channel.

(c) Reservoir, levees, and channel with landside levee borrow.

(d) Reservoir and levee alinement with channel adjacent to the levees.

(e) Reservoir and channel alinement with levees adjacent to the channel.

(f) Reservoir and levee alinement with clearing and snagging of the river.

(g) Reservoir and levee alinement with clearing and snagging plus major bend cutoffs.

(h) Reservoir and levee alinement with selected major bend cutoffs.

(i) Reservoir, levees, and channel with channel bottom raised 5 feet.

(2) Alternatives which would only provide a partial solution to all or part of the objectives

(a) Reservoir only.

(b) Reservoir and selective flood proofing by ring levees.

(c) Reservoir with animal refuge mounds.

(d) Reservoir and nonrestrictive easement acquisition of the flood plain.

(e) Reservoir and restrictive easement acquisition of the flood plain.

(f) Reservoir and fee purchase acquisition of the flood plain.

(g) Channel only.

(h) Levees only.

(i) Channel and levees.

b. Nonstructural

(1) Flood plain regulation.

(2) Flood plain acquisition.

(3) Flood insurance.

(4) Flood warning and evacuation.

c. No action

5. Comments Received:

a. FEDERAL

US Department of the Interior, Assistant Secretary for Program Development and Budget, Office of Environmental Project Review

Environmental Protection Agency, Regional Administrator, Region VI

US Department of Commerce, Deputy Assistant Secretary for Environmental Affairs

US Department of Agriculture, Texas State Conservationist, Soil Conservation Service

US Department of Agriculture, Regional Forester, Southern Region, Forest Service

US Department of Transportation, Division Engineer, Federal Highway Administration

US Department of Health, Education, and Welfare, Regional Director, Public Health Service, Region VI

US Public Health Service, Vector-Borne Diseases Division

Federal Power Commission, Acting Advisor on Environmental Quality

Advisory Council on Historic Preservation

b. STATE

State of Louisiana, Department of Public Works, Director (now Department of Transportation and Development, Office of Public Works)

State of Arkansas, Department of Local Services, Director (also transmitted comments from the Arkansas Game and Fish Commission and the Arkansas Historic Preservation Program)

State of Texas, Office of the Governor, Governor

c. ENVIRONMENTAL

Texas Committee on Natural Resources
Environmental Defense Fund
Ozark Society, Bayou Chapter

d. OTHERS

ARK-TEX Council of Governments

North Central Texas Council of Governments (also transmitted comments from the Mayor of the City of Commerce, the Assistant General Manager of the North Texas Municipal Water District, and the Grants Coordinator of the City of Irving)

University of Texas, Dr. Clark Hubbs, Witness for Plaintiff

Southern Methodist University, Dr. Alan Skinner, Research Archeologist

City of Irving, Texas, Mayor

Board of County Commissioners, Franklin County, Chairman

Mr. Albert Roach

Dr. Douglas S. Gale

Draft Statement to CEQ 10 June 1976

Final Statement to CEQ JUN 24 1977

COOPER LAKE AND CHANNELS, TEXAS

TABLE OF CONTENTS

Table of Contents (Cont'd)

Table of Contents (Cont'd)

Table of Contents (Cont'd)

Table of Contents (Cont'd)

*These appendixes were published in the draft EIS but have been removed and are on file and available for review at the New Orleans District office.

Table of Contents (Cont'd)

Table of Contents (Cont'd)

Table of Contents (Cont'd)

GENERAL NOTES

1. LEVEE DESIGNATIONS

The scope of the proposed and existing levee system of the Sulphur River basin is so extensive that a method for classifying the levees was devised to identify any particular levee with the area and tributary stream of the watershed. The following information shows the nomenclature used to identify the various levees. The exceptions to this numbering scheme are the levees located on the Middle and South Sulphur Rivers immediately above the authorized reservoir site. These levees were labeled A, B, C, and D for ease of reference as shown on the status quo plan drawing, Plate No. VI-16, in Section 6.

Bank of River (Right or Left Bank Designation Looking Downstream)

4-R-SS

Consecutive Levee Numbering Increasing Downstream

River to which levee is adjacent (can be S, SS, N, or C for Sulphur River, South Sulphur River, North Sulphur River, and Cuthand Creek, respectively)

Levee Designation	Description
1RSS	Levee No. 1 on right bank of South Sulphur River
2RSS	Levee No. 2 on right bank of South Sulphur River
3RSS	Levee No. 3 on right bank of South Sulphur River
4RSS	Levee No. 4 on right bank of South Sulphur River
1LSS	Levee No. 1 on left bank of South Sulphur River
2LSS	Levee No. 2 on left bank of South Sulphur River
3LSS	Levee No. 3 on left bank of South Sulphur River
4LSS	Levee No. 4 on left bank of South Sulphur River
5LSS	Levee No. 5 on left bank of South Sulphur River
5RSS	Levee No. 5 on right bank of South Sulphur River
1RS	Levee No. 1 on right bank of Sulphur River
2RS	Levee No. 2 on right bank of Sulphur River
1RN	Levee No. 1 on right bank of North Sulphur River
3RS	Levee No. 3 on right bank of Sulphur River

4RS	Levee No. 4 on right bank of Sulphur River
1LS	Levee No. 1 on left bank of Sulphur River
2LS	Levee No. 2 on left bank of Sulphur River
3LS	Levee No. 3 on left bank of Sulphur River
5RS	Levee No. 5 on right bank of Sulphur River
6RS	Levee No. 6 on right bank of Sulphur River
7RS	Levee No. 7 on right bank of Sulphur River
8RS	Levee No. 8 on right bank of Sulphur River
9RS	Levee No. 9 on right bank of Sulphur River
5LC	Levee No. 5 on left bank of Cuthand Creek
A	See Status Quo Map for location above the reservoir site
B	See Status Quo Map for location above the reservoir site
C	See Status Quo Map for location above the reservoir site
D	See Status Quo Map for location above the reservoir site

2. RIGHT-OF-WAY

As used in this document, the term "right-of-way" does not necessarily connote that an interest lesser than fee title acquisition is involved. Appropriate meaning should be derived from the particular context in which the term is used.

SECTION 1--PROJECT DESCRIPTION

1.01 GENERAL

The selected plan for improvement in the Sulphur River Basin above Wright Patman Lake is a coordinated effort to combine the most economical and desirable aspects of a multipurpose reservoir, levees, and an improved channel to provide water supply, recreation, and flood control. The flood protection provided will essentially eliminate major flood losses for events less than or equal to the 30-year flood. Prior to the authorization of a flood protection plan in the Sulphur River Basin above Wright Patman Lake, some channel improvements were undertaken by the local interests. Reaches of North and South Sulphur Rivers were realined during the 1920's. In addition, reaches of the Sulphur River were realined in the early 1950's by the Corps of Engineers. Since authorization by Congress in 1955, portions of the Cooper Lake and Channels project have been completed in accordance with the authorization. Levee and channel work upstream of Cooper Lake along South Sulphur and Middle Sulphur Rivers was completed in 1959. Other work accomplished includes channels and levees along several tributaries and some works along Sulphur River below Cooper Lake. In June 1976, the draft environmental impact statement (EIS) was coordinated for review with Federal and state agencies, environmental groups, and the general public. This statement presented, in a systematic format, the environmental data upon which a decision, with respect to a plan of action, could be based. To assure widespread exposure of the contents of the EIS and to insure that the full range of public views and perceptions would be brought to bear in the decision making process, a public meeting to review the statement was held on 31 July 1976. The preparation of the draft EIS and the process of public review to which it was subjected served to insure that the environmental data base available to the decision makers was as comprehensive as possible. Based on the oral testimony given at the public meeting and the written statements of comment submitted during coordination, two distinct issues surfaced: (1) the need for an adequate supply of surface water and downstream flood control, as stressed by area residents and governing bodies and (2) the opposition to a channel as a means of providing downstream flood control, as stressed by environmentally concerned agencies, groups, and individuals. Based on these observations, the decision was made to modify the plan presented in the draft EIS to eliminate most of the uncompleted channel work. The currently

recommended plan as presented in this document is the alternative, "Reservoir and Levees" in the draft EIS, hereafter referred to as the selected plan. The selected plan represents a modification of the draft EIS "authorized plan" within the discretionary authority of the Chief of Engineers. The selected plan would provide the needed water supply, essentially the same degree of downstream flood protection, and would greatly reduce further destruction of natural aquatic habitat. Completion of the selected plan would require construction of the following features:

a. A multipurpose reservoir with a dam, spillway works, and spillway outflow channel on the South Sulphur River at mile 23.2.

b. Enlargement and/or extension of existing levees and the construction of new levees to provide flood protection from the damsite to just above State Highway No. 26 (US Highway No. 259).

c. Extension of an existing channel and the construction of a new channel where levee construction necessitates cutting off natural channel bends.

1.02 LOCATION

The reservoir would be located near Cooper, Texas, on the South Sulphur River in Delta and Hopkins Counties (plate I-1). The dam and service spillway will be located at mile 23.2 on the South Sulphur River. Levee improvements will be located downstream of the reservoir area, on the South Sulphur River, and along the main-stem of the Sulphur River upstream of Wright Patman Lake.

1.03 PLAN, PURPOSE, STATUS, AND BENEFIT/COST RATIO

a. Plan and purpose

(1) Reservoir. The reservoir would be a multipurpose project for municipal and industrial water supply, flood control storage and recreation (see table I-1). The reservoir will contain 273,000 acre-feet of storage space allocated to water supply purposes. The water supply storage space will produce a firm yield of 169 c.f.s. (cubic feet per second) [109 m.g.d. (million gallons daily)] for municipal and industrial water uses and low flow releases. The reservoir will contain 131,400 acre-feet of flood control storage space to effect a reduction in flood flows below the dam. This storage will also permit a conversion of a portion of the existing storage space in Wright Patman Lake from flood control to water supply. In order to retain the same degree of

flood protection below Wright Patman Lake, the operation of Cooper Lake will be coordinated with the operation of Wright Patman Lake. Normal releases from Cooper Lake will be regulated to a maximum release rate of 3,000 c.f.s. Multilevel outlets are provided in the project design. Among these outlets are four 6-foot by 6-foot sluices with inverts at elevation 398 feet m.s.l. These sluices will be used in making flood releases. There are also two 2-foot by 3-foot openings in one of the service spillway piers with invert elevations of 422 and 436 feet m.s.l. These outlets will be used in making low flow releases. Additionally, floods that require the use of the service and emergency spillways will flow over weirs set at elevations 426.2 feet m.s.l. and 450 feet m.s.l., respectively. All releases through the service spillway will be discharged into the South Sulphur River through the spillway outflow channel. The main outflow channel will have a base width of 476 feet and will extend approximately 1,400 feet downstream from the spillway stilling basin until the natural ground elevation falls below elevation 400.0 feet m.s.l. A 476-foot-wide cleared floodway would extend an additional 3,500 feet to the point where the spillway outflow channel meets the South Sulphur River. In the center of this main outflow channel, a pilot channel with a 40-foot bottom width will extend from the spillway stilling basin approximately 4,900 feet to the South Sulphur River. Normal flood releases from Cooper Lake will be in accordance with a schedule based on the ratio of Cooper Lake flood control pool percent occupied to the Wright Patman Lake flood control pool percent occupied. An established rule curve will prescribe the operational plan for Cooper Lake. That rule curve requires that flood control capacities be preserved by making releases from the lake when water levels exceed elevation 440.0 feet m.s.l. The space between elevations 415.5 and 440.0 is reserved for water supply. This space has been contracted for purchase by local entities. The fluctuation of water levels between these elevations will be primarily influenced by the rates of withdrawal by such entities, by the rate of inflow to the lake, and by evaporation, transpiration, and infiltration. The water level within the range described will be affected through reservoir operational procedures, i.e., maintaining a minimum low flow release of 5 c.f.s., and such excesses over that amount as may be necessary for vector control. Cooper Lake also includes 37,000 acre-feet of storage space as a reserve for sedimentation. The reservoir will entrap inflowing sediments and reduce the sedimentation in the region downstream of the dam, especially in the reach between the proposed damsite and the confluence of the North and South Sulphur Rivers. In addition to the boating, fishing, and hunting opportunities provided by the reservoir, other recreational facilities would be proposed. Public access to the dam's tailrace and outflow features will be incorporated into detailed designs for

Table I-1

Project Statistics

Physical Data:

Dam

Type: Rolled earthfill (lake side of dam will have an 18-inch blanket of riprap)
Height: 40 feet average, 73 feet maximum
Length: 15,882 feet
Crest Elevation: 459.0 feet m.s.l.

Service Spillway

Type: Controlled Ogee
Gates: Five 40 foot by 20 foot tainter gates
Length of Crest: 200 feet (net)
Crest Elevation: 426.2 feet m.s.l.

Outlet Works

Type: Gate - controlled conduits
Location: One outlet in each four piers
Sluices: Four 6 feet by 6 feet
Invert Elevation: 398.0 feet m.s.l.

Emergency Spillway

Type: Uncontrolled broad crested weir
Length: 4,200 feet
Crest Elevation: 450.0 feet m.s.l.

Reservoir Capacity

Pool Description	Elevation Feet, m.s.l.	Pool Storage Capacity Acre-Feet	Surface Area (Acres)	Mean Depth (Feet)
Sedimentation	415.5	37,000	5,084	7
M&I Water Supply	440.0	273,000	19,305	16
Flood Control	446.2	131,400	22,740	19

Reservoir Yield

M&I Water Supply	164 cfs (105.8 mgd)
Low Flow Release	5 cfs (3.2 mgd)
Total	169 cfs (109.0 mgd)

Table I-1 (Cont'd)

Recreation Pool Perimeter

The recreation pool is equivalent to the top of the water supply pool (440.0 feet, m.s.l.) and has a shoreline length (perimeter) of 58 miles.

Levees in Total Project	Completed	Remaining
Upstream from Dam	7.4 miles	-
Downstream from Dam	39.9 miles	26.9 miles

Channelization in Total Project	Completed	Remaining
Upstream from Dam	18.4 miles	-
Downstream from Dam	18.8 miles	6.6 miles

Water Supply Contracts:

Cooper Reservoir	Initial Storage Space	Future Storage Space
City of Irving, Texas	46,200 acre-feet	100,625 acre-feet
North Texas Municipal Water District	0	100,625 acre-feet
Sulphur River Municipal Water District	17,750 acre-feet	71,750 acre-feet
Total	63,950 acre-feet	273,000 acre-feet

Wright Patman Lake (formerly Lake Texarkana)

City of Texarkana, Texas (After conversion of existing flood control space)		120,000 acre-feet

the dam. Thirty-three hundred acres of land at seven sites would be available for recreational development. Adequate roads and parking facilities would be developed for visitors. Other facilities which include boat launching ramps, trails, picnicking and camping areas, potable water supplies, comfort stations, shelters, beaches, and safety features would be provided based on the number of annual visitors. Facilities would be so located as to utilize and enhance the natural beauty of all sites. Landscaping would be accomplished to compliment the surrounding natural beauty and to establish vegetative growth over the construction areas. Details on appurtenant recreation and comfort facilities associated with the project will be addressed in a recreation master plan report that will be prepared in the future.

Completion of the reservoir would require the following alterations or relocations:

(a) Railroads. The Southern Pacific Transportation Company owned and operated the Texas and New Orleans Railroad traversing Middle Sulphur River, Journigan Creek, Johns Creek, and Doctors Creek within the proposed reservoir area. This trackage was damaged extensively by an October 1971 flash flood and by a subsequent fire. Southern Pacific Transportation Company petitioned Interstate Commerce Commission to permit abandonment of the line between Commerce, Texas, and Paris, Texas, extending through the proposed reservoir area. Abandonment was authorized by Interstate Commerce Commission effective 6 June 1975; no repairs were made to the damaged trackage between October 1971 and June 1975 and none will be made. Prior to abandonment, preliminary planning indicated the need for realining several miles of trackage on a raised and armored roadbed and the modification or replacement of existing trestles. As envisioned at this time, acquisition of any Southern Pacific Transportation Company interest in the right-of-way and trackage remaining in the reservoir area will not include relocation of facilities.

(b) Roads

1. Relocations. Existing roads in the area serve the normal need for the transportation of farm produce to market centers. Some are used as mail and school bus routes, and all are used for general transportation requirements. The reservoir construction would require the relocation or alteration of 1.1 miles of FM. 1528 (including two bridges) and the construction of a 0.8-mile section of new road (Harper's Crossing Connecting Road).

2. Abandonment. Several minor roads, including FM Road No. 1880 and the Harper's Crossing Road, are

scheduled for abandonment for a combined total length of approximately 7 miles within the reservoir area.

(c) Utilities

1. The construction of Cooper Lake would require the relocation or alteration of the following:

Owner		Description of Relocation	Length
Gulf States United Telephone Company	GS-1	Remove and salvage aerial exchange cable, abandon in place buried exchange cable, install new buried exchange cable.	0.3 mi. 0.3 mi. 0.3 mi.
	GS-2	Remove and salvage aerial exchange cable, abandon in place buried exchange cable, install new buried exchange cable	0.7 mi. 0.7 mi. 0.7 mi.
	GS-3	Abandon in place buried exchange cable Install new buried exchange cable	0.7 mi. 0.7 mi.
	GS-4	Abandon in place buried exchange cable	1.5 mi.
	GS-5	Remove and salvage existing pole line	2.2 mi.
	GS-6	Remove and salvage existing pole line install new buried exchange cable	0.8 mi. 0.7 mi.
	GS-7	Remove and salvage existing pole line	0.3 mi.
	GS-8	Remove and salvage existing pole line	0.3 mi.
Lone Star Gas Company		Secure a damage release from Lone Star Gas Company concerning their facilities which will remain in place inside the proposed reservoir boundary	1.8 mi.
Texas Power and Light Co.	TP-1	Remove and salvage existing distribution line	19.2 mi.
	TP-2	Remove and salvage existing transmission line Install new transmission line	0.4 mi. 0.8 mi.
	TP-3	Install new distribution line	0.4 mi.
	TP-4	Raise in place existing transmission	

Owner		Description of Relocation	Length
Farmers Electric Cooperative, Inc.	FE-1	Raise in place existing transmission line	0.7 mi.
	FE-2	Remove and salvage existing distribution line	1.2 mi.
	FE-3	Remove and salvage existing distribution line	1.1 mi.
	FE-4	Remove and salvage existing distribution line	1.9 mi.
	FE-5	Install new distribution line	0.9 mi.
	FE-6	Remove and salvage existing distribution line	1.5 mi.
	FE-7	Remove and salvage existing distribution line	1.0 mi.
		Install new distribution line	0.7 mi.
	FE-8	Remove and salvage existing distribution line	1.1 mi.

2. The existing water supply facilities ("City Lakes") of the City of Cooper, Texas, will be dislocated by the operation of the emergency spillway. Water passing over the emergency spillway will be conveyed to the South Sulphur River via a natural ravine which traverses the area of the existing facilities. Eight plans treating this eventual dislocation are being considered. Two plans which appeared to offer the most promise are:

a. A proposal recently indorsed by representatives of the city of Cooper, Texas, whereby the existing "City Lakes" would be acquired by the Federal Government on the basis of replacement of function cost rather than fair market value; ostensibly funds paid by the Federal Government would be utilized by local interests to secure an alternate supply of water to serve the community's needs until realization of potable water from Cooper Lake.

b. An in-house, US Army Corps of Engineers, plan which provides for two-phase construction of the

emergency spillway such that the service provided by the existing facilities would not be interfered with during construction of the emergency spillway, and consequently, dislocation of the extant facilities would not be required until after successful implementation of water supply to the city of Cooper, Texas, from the Cooper Lake project.

(d) Cemeteries. Approximately 416 graves from the following cemeteries must be relocated:

1. Friendship Cemetery is located approximately 1.3 miles southeast of Klondike. Approximately 171 graves are located in this cemetery and all of these will require relocation.

2. Liberty Grove Cemetery is located along FM Road No. 1880, approximately 2 miles south of the town of Cooper, Texas. Approximately 231 graves are located in this cemetery, and all of these must be relocated.

3. Tucker Cemetery is located approximately 3.5 miles southeast of Cooper, Texas, and is located within the proposed damsite area and therefore, requires relocating to a new site. Approximately 14 graves are involved.

4. Dawson Cemetery is located about 0.5 miles west of the north abutment of the dam, and is almost totally above elevation 451.2, the guide-taking contour. The entire cemetery is, however, within 300 feet of the top of flood control pool. The small portion of the cemetery area which is below elevation 451.2 would be raised to that elevation and the criterion that the guide-taking line be at least 300 feet horizontally distant from the edge of the flood control pool will be waived in this immediate area to avoid disturbing the cemetery.

(2) Levees

(a) Downstream from dam. Flood control levees would be improved from the authorized damsite to the confluence of Cuthand Creek and the Sulphur River. The levee work would include enlargement, extension, or construction of new levees. The length and volume of fill required for the remaining levee work is as shown in the following tabulation:

Levee	Stream	Length	Volume (C.Y.)
(Ext) 4RSS (Spur)	South Sulphur	5,000'	25,000
(Ext) 4LSS	South Sulphur	25,100'	255,000
(Ext) 3RS (Spur)	Sulphur	4,284'	
(Ext) 3RS	Sulphur	22,000'	2,850,000*
(E) 3RS	Sulphur	34,544'	
(N) 4RS	Sulphur	51,600'	2,195,000

E - Levee enlargement
Ext - Levee extension
N - New levee
* - Total 3RS

Since the present Levee 4RSS would be cut by the service spillway discharge channel, an extension spur levee [4RSS (Spur)] approximately 5,000 feet long would be alined parallel to and east of the proposed outlet channel. Levees 4RS, 3RS, and 4LSS were designed as open end levees and interior runoff would be discharged into the river channels through natural drainage channels and landside drainage ditches. However, a single 48-inch corrugated metal pipe culvert with an automatic flap gate is proposed for construction at station 258+30 on Levee 4RS and at station 5+00 on Levee 4LSS in order to drain water from low areas in the drainage system. Levee 4RSS was designed as a loop levee and interior runoff would be discharged through the levee during low river stages by corrugated metal pipe culverts with automatic flap gates. Concrete headwalls would be provided on the riverside end of the existing and proposed culverts. On the landside end, headwalls have not been indicated, as it was found to be more economical to extend the conduit and to provide rock riprap for the erosion protection of the structure. Outlet ditches from the drainage culverts would have a minimum bottom width of 12 feet and 1 on 1 side slopes. Improvements along the North Sulphur River and along Cuthand and Brushy Creeks have been completed. Acquisition of rights-of-way for levee construction does not include the right to utilize these areas for recreational activities. Reservation of levees as rights-of-way for recreation trails by the Federal Government would require further authorization from Congress. When completed, the levee system would be turned over to local interests for maintenance, with the Federal Government retaining jurisdiction to insure that the system is being properly maintained and not being used for anything which might undermine the integrity of the levees. If local interests wish to utilize the levee rights-of-way as recreation trails, their

plan should be submitted to the New Orleans District Engineer for evaluation, after the levees have been completed.

(b) Upstream from dam. All levees upstream from the dam are complete. The total length of levees completed in this stretch is 7.4 miles.

(c) Relocations. It would be necessary, in connection with the levee construction, to alter or to relocate the following utility line crossings:

Levee Station	Type Line	Stream
489+00 (5RSS)	Pipeline	South Sulphur River
199+00 (3RS)	Pipeline	Sulphur River

It is possible that additional alterations or relocations may be required which have not been determined. This possibility has been taken into consideration in the relocation cost estimate for this project.

(3) Channels

(a) Downstream from dam. Channel realinement and floodway clearing will be required where proposed levees will cut off the natural channel. This will occur on the South Sulphur River adjacent to levee 4LSS and on the Sulphur River adjacent to levee 4RS. On the South Sulphur River, the alinement of levee 4LSS will require the construction of approximately 19,000 feet of realined channel with a bottom width of 12 feet and flanked on both sides by a 75-foot cleared floodway measured from the centerline of the channel. This construction will require the excavation of approximately 451,000 cubic yards of material and the clearing of approximately 65 acres of land. On the Sulphur River in the vicinity of levee 4RS, a reach of approximately 31,900 feet of realined channel and cleared floodway would be required. This entire reach was previously cleared to the required 150-foot width and 16,000 feet of 12-foot bottom width realined channel was previously excavated. The construction of 15,900 feet of realined channel is the remaining requirement. This would involve the excavation of approximately 192,000 cubic yards of material. Some minor reclearing and reexcavation in the previously completed area may be necessary in order to restore the area to the required condition. To the extent practicable, excavated material from required channelization would be used in levee construction. Excavated material not used in this fashion would be disposed of by casting in uncompacted disposal areas. Openings would be left in the disposal areas as required to provide for natural drainage. A minimum berm of 50 feet would

be left between the top edge of the excavated channel and the riverside toe of the disposal area in order that future enlargement of the channel would not remove the disposal area. The embankments of dredged material would be limited in height to about 10 feet. Channel improvement along Brushy Creek and Cuthand Creek have been completed.

(b) Upstream from dam. Channel work upstream from the dam is complete. The total length of channelization completed in this area is 18.4 miles.

b. Status of project

(1) As noted in previous paragraphs, portions of the Cooper Lake and Channels project have been completed since authorization by Congress in 1955. Levee and channel work upstream of Cooper Lake along South Sulphur and Middle Sulphur Rivers was begun in 1958 and completed in 1959. The work consisted of 18.4 miles of realined river channel, clearing of a floodway along the realined channel, improvement of 7.9 miles of agricultural levees, modification of three drainage culverts, and alteration of three railroad crossings. The channel and floodway work consisted of realining the Middle and South Sulphur Rivers by excavation of a new channel and clearing a floodway. Construction of the levee and channel improvements downstream of Cooper Lake commenced in September 1959 and continued intermittently as rights-of-way and funds became available. Lack of funds and spending limitations prevented construction of levees and channels between April 1964 and February 1971. These delays in the downstream work exposed previously completed levees to scour. During this period, flooding caused overtopping and degrading of the levees, silting of flapgate culverts, and flooding of adjacent farmland. Texas Highway 37 bridge was being exposed to damage due to debris accumulation on its substructure. On 10 February 1971, a contract was awarded for construction and rectification of approximately 23 miles of levee and 33 miles of channel improvement and realinement of the Sulphur River between the Magnolia pipeline at mile 131 and US Highway 271 at mile 174. The work would have required approximately 1.5 years to complete. Additional contracts were to be let shortly thereafter. Previous flood damage to levees was to be repaired as work progressed through the area. In May 1971, however, the US District Court for the Eastern District of Texas, acting on a motion for preliminary injunction by the Texas Committee on Natural Resources, et al., halted further construction on the project until an environmental statement was filed with the President's Council on Environmental Quality (CEQ). The work downstream of Cooper Lake which had been completed by that time included the construction of

about 15 miles of realined channel and floodway clearing and about 15 miles of agricultural levee improvement on Cuthand Creek, and levee work and about 1 mile of realined channel and floodway clearing on Brushy Creek. Approximately 30,000 feet of channel floodway clearing was accomplished from Cuthand Creek upstream on the Sulphur River. In addition to clearing, approximately 16,000 feet of channel excavation was performed above the 30,000-foot strip before project construction was halted. Channel work on Cuthand Creek and Brushy Creek had been completed since 1959 as well as levee work related to these tributaries and the North Sulphur River. Approximately 5 miles of levee work on the South Sulphur River was completed. Up to the time of injunction, levee and channel work upstream of the reservoir was 100 percent complete and work below the reservoir was approximately 50 percent complete. This condition is now referred to as the status quo and is used as the base from which the impacts of the selected plan and all the alternatives were assessed. Subsequent to the court action, the Office of Counsel, New Orleans District, Corps of Engineers, requested a ruling as to the effects of the injunction upon planning, real estate acquisition, and other nonconstruction activities associated with the project. These functions were permitted by the court. As of the end of calendar year 1975, approximately 80 percent of the lands in the impoundment area had been acquired in fee.

(2) Immediately after the court imposed the injunction against further construction, the New Orleans District (NOD) began to evaluate the factors relevant to the project and to prepare the draft environmental impact statement. In order to assure the adequacy of the data used to formulate the EIS, NOD contracted with East Texas State University, Commerce, Texas, for an environmental inventory of the Sulphur River Basin and with URS/Forrest and Cotton, Inc., Dallas, Texas, for a study of reasonable alternatives to the draft EIS plan. The data acquired from these studies served as the nucleus around which the EIS was developed. In addition, the personal services of professional environmental consultants were engaged to provide input to and edit the EIS. The draft document was circulated for review in June 1976, and on 31 July 1976, a public meeting was held to further examine the needs and desires of the general public. Based on the oral testimony delivered at the public meeting and the written statements now incorporated into Section 9 of this document, a decision was made to minimize further construction of the authorized channel and to follow an alternative course of action involving the construction of a reservoir, downstream levees, and limited channels only. This alternative plan provides essentially the same degree of benefit while foregoing the unnecessary destruction of natural aquatic habitat.

c. Benefit/cost ratio. The current benefit/cost ratio for the selected plan is 1.5 to 1. The project is intended to serve its purposes over a useful life of 100 years.

1.04 OPERATION AND MAINTENANCE

a. Reservoir. Upon completion of the construction of the project, operation and maintenance activity will commence and will encompass the following:

(1) Operation and maintenance of structures to provide water supply, recreation, and flood control benefits; e.g., reservoir regulation.

(2) Operation and maintenance of recreational developments and facilities to preserve their usefulness and to minimize public health and safety hazards.

(3) Management activities for the protection, preservation, and enhancement of fish, wildlife, forest, land, water, and other natural resources.

(4) Monitoring studies to evaluate project operation, to assess effect of the project, and to provide historical data for planning and design criteria; e.g., condition and operation studies.

(5) Maintenance of buildings, equipment, and support systems required to accomplish the mission.

(6) Real estate and land management programs associated with encroachments, compliance inspections, leases, and permits.

Work associated with the above will generally be accomplished by government employees under the direction of the District Engineer, US Army Engineer District, New Orleans, except for service type contracts and major maintenance requiring special expertise. Maintenance of the public use road over the dam will be the responsibility of the Texas State Highway Department.

b. Levees. Maintenance of the levees outside of the reservoir boundaries would be the responsibility of local interests. This would consist of occasional mowing and inspections to observe levee and drainage structure conditions. If necessary, the local interests would be required to make minor repairs.

1.05 AUTHORIZATION

a. Authorization for construction. Congressional authorization for the construction of the Cooper Lake and Channels, Texas, project is contained in the Flood Control Act approved 3 August 1955 (Public Law 218, Chapter 501, 84th Congress, 1st Session). The act authorizes the construction of the Cooper reservoir and channel and levee improvement ". . . substantially in accordance with the construction plans recommended in the report of the Chief of Engineers in House Document Numbered 488, Eighty-third Congress, 2nd Session: PROVIDED, That local interests shall contribute toward the costs of construction, maintenance, and operation of Cooper Reservoir the amounts allocated to water supply; and shall, with respect to other features of the modified project, give assurances satisfactory to the Secretary of the Army that they will:

(1) Provide without cost to the United States all lands, easements, and rights-of-way, and make alterations and relocations of highways and related facilities, and utilities except railroads, necessary for the construction;

(2) Hold and save the United States free from damages due to the construction; and

(3) Maintain and operate all works after completion, and preserve channel capacities by preventing encroachment, in accordance with regulations prescribed by the Secretary of the Army."

b. Authorization for advanced planning. Authority to initiate advance planning on the Cooper Lake and Channels project is contained in the Public Works Appropriations Act of 1957 approved 2 J 1956 (Public Law 641, 84th Congress, 2nd Session).

1.06 INTERRELATIONSHIP AND COMPATIBILITY OF PROJECT WITH EXISTING OR PROPOSED CORPS OR OTHER AGENCY PROJECTS

a. The Cooper Lake project is related to the Wright Patman Lake project in that the construction of the 131,400 acre-foot flood control pool at Cooper will permit the conversion of 120,000 acre-feet of existing flood control space in Wright Patman Lake into water supply space. The flood control pool at Cooper Lake provides upstream substitute flood control storage for the space that will be converted at Wright Patman Lake, and thus, will not impair the present level of flood protection below Wright Patman

Lake. The conversion is only possible if and after Cooper Lake is completed.

b. The completion of Cooper Lake merely makes possible the reallocation of storage space at Wright Patman Lake. This reallocation is not mandated by the authorizing legislation for the Cooper project; it is, however, permitted by that legislation. The decision to implement this feature will be a future determination, and in accordance with the policies prescribed by the National Environmental Policy Act of 1969, an environmental statement for this action will be prepared prior to implementation. The Cooper project is independently justified and could be implemented irrespective of whether or not 120,000 acre-feet of storage space at Wright Patman Lake is reallocated from flood control to water supply. Since the proposed conversion at Wright Patman Lake will be dedicated to municipal and industrial water supply, all direct costs associated with that conversion must be fully reimbursed by local interests. The city of Texarkana, Texas, has contracted for the purchase of the water supply space that will be available in Wright Patman Lake if the conversion is accomplished.

c. The conversion of space at Wright Patman Lake would produce the following results:

(1) The storage allocations now existing in Wright Patman Lake would be affected as shown in the following table.

Wright Patman Lake - Storage Allocations

Feature	Unit	Existing Project	With Cooper Lake in Operation
Conservation Pool			
Elevation	ft. m.s.l.	220	220
Area	acres	20,300	20,300
Storage	acre-feet	145,300	145,300
Water Supply Pool and/or other Conservation Uses Pool			
Elevation	ft. m.s.l.	-	224.9
Area	acres	-	29,000
Storage	acre-feet	-	120,000
Flood Control Pool			
Elevation	ft. m.s.l.	259.5	259.5
Area	acres	119,700	119,700
Storage	acre-feet	2,509,000	2,389,000

(2) Approximately 74,600 acres of land between elevations 235.0 feet mean sea level (m.s.l.) and 265.0 m.s.l. would be acquired in fee title. These lands are now covered by flowage easements acquired in connection with the original taking for Wright Patman Lake. Approximately two-thirds of this land is wooded and the remaining one-third is pastureland.

(3) A permanent water supply pool would be established between elevation 220.0 feet m.s.l. and 224.9 feet m.s.l., resulting in the permanent inundation of approximately 29,000 acres of land below elevation 224.9. At present, approximately 20,300 acres of land are inundated by the minimum pool level at elevation 220.0. This increase in the minimum pool will require the clearing of approximately 1,600 acres of shoreline lands between elevations 220.0 and 224.9.

(4) The conversion of storage space at Wright Patman Lake will require modifications and/or relocations activities as follows:

(a) The St. Louis Southwestern Railroad embankment will require riprap protection between elevations 245.0 and 248.0 and the addition of 0.9 mile of 30-foot-wide stability berm on both sides of the embankment at elevation 235.0.

(b) The US Highway No. 67 roadway will require about 1.8 miles of stability berm at elevation 235.0 on the lake side of the embankment.

(c) State Highway No. 8 roadway will require about 1.2 miles of 30-foot-wide stability berm at elevation 235.0 on both sides of the embankment.

(d) About 0.7 miles of Minton Road and one 320-foot bridge would be raised to elevation 234.0 and wave wash protection would be required on the lake side of the roadway embankment.

(e) About 0.5 miles of Jackson and Webster Creek road and two timber bridges would be raised to elevation 235.0.

(f) Recreation facilities would be affected in that three swimming beaches would be relocated and 15 boat launching ramps would be extended 32 feet each.

(5) After completion of Cooper Lake, an operating plan for the coordinated routing of flood discharges through the two reservoirs will be implemented. That plan was formulated toward

uniform filling and emptying of the two flood control pools; under the plan, the following procedures are contemplated:

(a) Wright Patman Lake flood control release rate will be varied up to a maximum controlled release of 10,000 c.f.s., as required to maintain lake levels indicated by the permanent operating rule curve in effect after Cooper Lake is built.

(b) The Cooper Lake flood control release rate is based on the ratio of the Cooper Lake flood control pool percent filled to the Wright Patman Lake flood control pool percent filled. Adjustments in the release rate would be made daily. The release rates corresponding to ratio values are as follows:

Ratio Percent Cooper Flood Control Pool Filled to Percent Wright Patman Flood Control Pool Filled	Cooper Lake Flood Control Release, c.f.s.
0 to 0.25	0
0.25 to 0.50	750
0.50 to 0.75	1,500
0.75 to 1.00	2,250
Greater than 1.00	3,000

SECTION 2--ENVIRONMENTAL SETTING WITHOUT THE PROJECT

2.01 GENERAL DESCRIPTION

a. Geographic location (refer to plate II-1). The Sulphur River Basin is in northeast Texas and southwest Arkansas. The river originates in Fannin and Hunt Counties, Texas, and flows eastward approximately 300 miles to its confluence with the Red River in Miller County, Arkansas. The river basin averages 25 miles in width and includes portions of Fannin, Hunt, Lamar, Delta, Hopkins, Red River, Franklin, Morris, Titus, Bowie, and Cass Counties in Texas and Miller County, Arkansas. For the environmental setting, the Sulphur River Basin is discussed at a regional and project level. The basin area proper includes the 12-county area mentioned above. In addition, evaluation of socioeconomic impact in the region is extended to include Wood, Rains, and Camp Counties, Texas. The project area includes that land area to be affected by the proposed construction. This area of about 90,000 acres is defined by the 30-year frequency flood area within the basin. It is within the project area that the proposed project and alternatives will have direct or indirect impact upon the zoological and botanical elements. This area includes the flood plain zones of Lamar, Delta, Hopkins, Franklin, Titus, Bowie, Morris, and Red River Counties, Texas.

b. General description of the Sulphur River Basin

(1) Physiography. The Sulphur River Basin lies in the northwest part of the Gulf Coastal Plain, a major geologic and physiographic province which extends from Florida westward to Yucatan, Mexico, and as far north as Illinois. The Coastal Plain generally consists of an overlapping sequence of sedimentary formations which dip gently southward to the Gulf of Mexico. The deposits range in age from Lower Cretaceous in the north to Pleistocene and Holocene near the Gulf Coast. The Sulphur River drainage is developed upon Cretaceous and Eocene age sediments that occur as narrow bands running west to east and that dip gently southward.

(a) The valley of the Sulphur River is marked by a well known system of normal faults called the Luling-Mexia-Talco fault zone. The faults lie in a narrow zone averaging 5 to 10 miles wide and extend from Miller County, Arkansas, on the east to near Commerce, Texas, in the west, where the fault zone swings to

the south. The faults are not active at present and there is no evidence of recent movements. In the subsurface these faults are of major economic importance as they serve as traps to halt the updip migration of petroleum and gas.

(b) Landscape features of the basin are entirely due to the process of stream erosion and deposition. The drainage pattern is controlled almost completely by the regional structure of southward dipping beds. The alternating beds of differing resistances to erosion have been shaped by stream erosion into a series of low cuesta type ridges trending east to west. The eastward flowing major streams have migrated laterally southward down the dip slopes of the beds so that the tributary streams from the north are greatly elongated relative to those from the south.

(c) Channel bottom gradients along the natural river are approximately 2.5 feet per mile. At this gradient, downward cutting by the stream is minimum and meander development is prominent. The gradients of channeled and realined portions of the river have been increased to about 5.0 feet per mile. This increase in gradient has caused some downward cutting, and a narrow trench several feet deep marks the low water thread of the stream. Many of the dredged streams are beginning to show some signs of lateral cutting, but in general the dredged portions still retain artificial character.

(d) The flood plains, those areas having alluvial deposits, of the major tributaries of the Sulphur River are, in general, from 1 to 2 miles wide. The flood plain width increases downstream to as much as 3 to 5 miles where the stream enters the Red River in Miller County, Arkansas.

(2) Climatic characteristics. Climate of the Sulphur River Basin is subtropical, dominated by the influence of maritime tropical air masses from the Gulf of Mexico. The average annual temperature is 64 degrees F, with a low of 44 degrees F in January and a high of 83 degrees F in July and August. The average length of growing season (average date of last killing frost in spring to first killing frost in fall) is about 235 days. Average annual precipitation is 41 inches, ranging from 38 to 47 inches within the basin. Most precipitation occurs as rain; however, snow does occur each year and the annual average is about 3 inches. Peak precipitation occurs during spring with drought conditions normally occurring during August and September.

(3) Terrestrial ecology. Three vegetational areas, described by Gould (1975), occur within the basin: (a) Blackland Prairies, (b) Post Oak Savannah, and (c) Pineywoods. Associated with these vegetational areas are certain wildlife species.

(a) Blackland prairies. The Blackland Prairies vegetational area within the basin comprises all or part of Delta, Fannin, Franklin, Titus, Hopkins, Hunt, Lamar, and Red River Counties (Gould, 1975). The topography is gently rolling to nearly level with rapid surface drainage. Upland soils of the Blackland are fairly uniform, dark-colored calcareous clays interspersed with some gray, acid sandy loams. Bottomland soils are predominately clayey. For the most part, this fertile area has been brought under cultivation, although some excellent native hay meadows and a few ranches remain.

1. Native vegetation of the Blackland Prairies is classed as true prairie with little bluestem as a climax dominant. Other important grasses include big bluestem, Indiangrass, switch grass, sideoats, grama, tall dropseed, silver bluestem, and Texas wintergrass. Under heavy grazing, Texas wintergrass, buffalograss, Texas grama, and smutgrass invade. Post oak and blackjack oak also increase on the medium to light textured soils under heavy grazing. Some excellent improved pastures have been established on cultivated lands. These have been seeded or sprigged in various grasses including Dallisgrass, common and coastal bermuda, and some native species.

2. The native grasslands support a variety of wildlife species. These include moderate populations of mourning dove and bobwhite and a rather abundant supply of eastern cottontails. Improved pastures provide rather poor wildlife habitat with respect to both food and cover requirements.

(b) Post Oak Savannah. Franklin, Titus, Morris, Fannin, Lamar, Red River, Bowie, Cass, and Hopkins Counties are totally or in part within the Post Oak Savannah vegetational area (Gould, 1975). Most authorities consider this plant association as a part of the oak-hickory or deciduous forest formation; whereas, others class the area as a part of the true prairie association of the grassland formation. The latter view is based on the fact that the understory vegetation is typically tall grasses, although in recent years brush and tree densities have increased tremendously from the virgin condition. Topography of the Post Oak Savannah is gently rolling to hilly. Soils on the uplands are light-colored,

acid sandy loams or sands. Bottomland soils are light-brown to dark-gray and acid, ranging in texture from sandy loams to clays.

1. Native vegetation includes such climax grasses as little bluestem, Indiangrass, switchgrass, and purpletop. The overstory is primarily post oak and blackjack oak, but many other brush and shrub species are also common. The Post Oak Savannah is mostly in native or improved pastures, although small farms are common. Brush control and good management have shown that the area is capable of producing an abundance of vegetation, primarily tall grasses. Improved pastures are commonly seeded or sprigged to coastal or common bermudagrass, vaseygrass, carpetgrass, and clovers. All classes of livestock are grazed, but cattle are the most common.

2. The additional cover provided by the numerous trees and shrubs of this area allows for a greater diversity of wildlife species than in the Blackland Prairies. Relative densities of individual species, however, do not vary significantly. The area supports huntable populations of mourning dove, bobwhite, eastern cottontail, white-tailed deer, and woodcock.

(c) Pineywoods. Counties of the basin which are totally or in part within the Pineywoods area are Titus, Morris, Bowie, and Cass Counties in Texas and Miller County, Arkansas (Gould, 1975). Topography is gently rolling to hilly. The soils are mostly light colored to dark-gray acid sands or sandy loam. The bottomland soils are loamy to clayey.

1. The area is interspersed with native vegetation, pasture, and farmlands. Ranches are variable in size and in type of operation; however, the principal livestock item is cattle. The major commercial timber species are loblolly and shortleaf pines. Many hardwoods, such as oaks, hickories, and gums are also present in the overstory. Most ecologists consider the pines as a subclimax or fire disclimax forest type. Grasses in the Pineywoods mainly consist of species of bluestems, dropseeds, paspalums, panicums, Indiangrass and others. Native legumes and occasional shrub species also contribute to the native forage production. Many other grasses are represented as well as extremely complex associations of forbs and brush species. Introduction of grasses and legumes for improved pastures have complicated the plant successional patterns. The most important of these introduced species are bermudagrass, Dallisgrass, vaseygrass, carpetgrass, and certain legumes.

2. Of the wide variety of wildlife in this region, the white-tailed deer draw the most concern. Improvement of its preferred habitat is often stressed in normal vegetation management procedures. Deer are especially compatible with the habitat created by prescribed burning techniques used to maintain the pine timber stands.

c. Project area. The project area supports a mosaic of vegetation units associated with the flood plain of the Sulphur River. The flood plain was originally a bottomland forest of hardwood species. Soils of the flood plain are primarily in the Kaufman and Gladewater series. They are mostly dark-gray to black, firm clays. Drainage ranges from moderately good to poor. This fertile, formerly forested flood plain is presently cultivated where drainage is satisfactory. However, in many areas the soil is too wet for farming and much of the flood plain has been converted to improved pastures or is grazed woodland.

2.02 GEOLOGICAL ELEMENTS

a. Introduction. The Sulphur River Basin is located along the northwestern margin of the gulf segment of the Coastal Plain Province. This province, a region of low relief bordering and sloping towards the Gulf of Mexico, is a vast sedimentary basin extending from Florida to Texas, and southward to the Yucatan Peninsula in Mexico. The exposed rocks, deposited in marine and nonmarine environments, range in age from Lower Cretaceous to Holocene. North of the study area in Arkansas and Oklahoma, the Gulf Coastal Province is bounded by the Ouachita Mountains, a stable region established during the Ouachita Orogeny. Two structural features more closely associated to the project area are the Sabine Uplift and the East Texas Syncline (plate II-2). These features dominate the regional structure in northeast Texas. The Sabine Uplift, with its center located in Caddo Parish in northwest Louisiana, is a dome approximately 80 miles long and 65 miles wide. Originally, the center of uplift occurred in east Texas, but shifted to its present position in the Cretaceous Period. Oldest strata exposed on the flanks of the dome are Midwayan sediments. The other structural feature, the East Texas Syncline, is a large negative feature that has received more than the normal amount of sediment accumulation since the Gulf Coastal Province came into existence. Structural maps reveal evidence of progressive growth, in both time and space, since at least early Jurassic. The northern and western portions of the syncline are controlled by and follow, generally, the trends of the Ouachita fold belt in the subsurface and adjacent Ouachita Mountains (Murray, 1961, pp. 123-125).

Stratigraphic studies indicate between 10,000 and 15,000 feet of Cretaceous and younger sediments have been deposited in the Sulphur River Basin portion of the East Texas Syncline. The strata in the project area dip southward at rates of slope ranging from 50 to 80 feet per mile, except where locally steepened or flattened by local structures. The southward dip direction and the southward decrease in the amount of dip indicates that a gradual but fairly uniform downwarping to the south concurrent with deposition has taken place since at least the early part of the Cretaceous period (Kolb, et al., 1958). Since Claiborne time, no marine deposition has occurred in the syncline proper.

b. Physiography and geomorphology

(1) General description. The proposed damsite and study area is situated near the northwestern margin of the Gulf Coastal Plain. Sediments within the area are separated into distinct physiographic units based on topographic position and origin or mode of deposition (see plate II-3). These units are the Cretaceous-Tertiary Uplands, the Pleistocene Terraces, and the Holocene Alluvial Plain.

(a) The Cretaceous-Tertiary Uplands are composed of beds of varying lithologies that support persistent topographic ridges and valleys trending generally northeast-southwest. The erosional contact between the Cretaceous and Tertiary deposits lies beneath the South Sulphur River flood plain. The damsite itself lies across the line that delimits these two major geologic periods on the surface, the contact occurring at shallow depths beneath the south abutment. Younger deposits are found towards the southeast with progressively older deposits occurring towards the northwest (see plate II-3).

(b) The Pleistocene Terraces are discontinuous, high level flood plain deposits, especially well developed along the northern margin of the main stream valleys in the area. These deposits were formed by streams in the Pleistocene Epoch, with gradients and load capacity much greater than the present-day streams. At the damsite, the terrace deposits underlie the northern embankment and form the north abutment. The terrace sediments, at least in this area, consist mainly of clay with minor amounts of silt and silty sand with a slight tendency toward coarsening of the deposit at the base, but sand and gravel are seldom encountered.

(c) The Holocene Alluvial Plain of the South Sulphur River varies in width from 1 to 2 miles. At the damsite, the alluvial deposits fill a valley entrenched chiefly into the Kincaid Formation. The Recent alluvium can be divided into a topstratum composed almost entirely of fat clay and a substratum consisting of lean clay, silt, and silty sand and clay sand. Gravel is occasionally found at the base of the unit.

(2) Elevations and relief. The highest elevations of the Sulphur River Basin occur in the headwater area to the west of the damsite. Topographic relief in the basin ranges from an elevation of about 759 feet above sea level in the Honey Grove-Bonham area to a low of about 190 feet above sea level at the confluence of the Sulphur and Red Rivers in Arkansas. Local relief is usually no more than 50 to 100 feet in a distance of several miles. In the immediate vicinity of the dam, elevations of the South Sulphur River flood plain vary between 395 to 405 feet m.s.l. The terrace surface rises northward from an elevation of 405 feet m.s.l. at the borders of the flood plain and merges with the Cretaceous uplands north of the town of Cooper at an elevation of approximately 470 feet above sea level.

(3) Geomorphology. The surface features of the Sulphur River Basin result entirely from the processes of stream deposition, land surface uplift, and erosion. No evidence of glaciation, vulcanism, or wind-formed geographic features has been noted.

(a) The drainage pattern of the basin is controlled by the regional structure of the southward dipping beds. Alternating beds of differing resistance to erosion have been shaped by stream action into a series of low ridges trending east-west. The eastward flowing major streams have migrated laterally southward down the dip slopes of the beds, such that tributary streams from the north are elongated in comparison with tributaries from the south. For example, the divide between the Red River and the North Sulphur River lies 10 to 15 miles north of the North Sulphur River, but the divide between the North Sulphur River and the Middle Sulphur River is only 2 to 4 miles south of the North Sulphur River. Rates of slope in the north drainage area of the North and Middle Sulphur Rivers average 10 to 15 feet per mile, but rates of slope in the south drainage area of these same streams are 30 to 50 feet per mile. These figures are typical of the upper half of the Sulphur River system. In the lower half, the rates of slope are even less, ranging from 5 to 10 feet per mile on the south drainage area (East Texas State University, 1971, pp. 94-95).

In this region, the trace of the erosional contact between the Cretaceous and Tertiary strata lies close to the southern edge of the South Sulphur River flood plain. The site of the dam itself crosses the surface contact of these two major geologic systems (see plate II-3). The geologic section in the area is obscured and complicated by the extreme structural dislocations along the Luling-Mexia-Talco fault system. This series of major faults is subparallel to the trend of the Cretaceous-Tertiary contact through northeastern Texas (see plate II-2). Several faults pass through or near to the proposed site (see plate II-3).

(b) The watershed of the South Sulphur River has a total area of 476 square miles above the proposed damsite and has a linear westerly extent of about 38 miles. This watershed consists of the combined drainage systems of the Middle Sulphur River and the South Sulphur River. Above their confluence, the drainage basin of the Middle Sulphur River is 133 square miles, and that of the South Sulphur River is 208 square miles. Between their juncture and the damsite, there is a drainage area of 135 square miles. The Middle Sulphur River rises in Fannin County near the Fannin-Hunt county line at an elevation of about 680 feet above mean sea level and it flows to the south and eastward until it joins the South Sulphur River. The South Sulphur River rises farther west in Fannin County about 10 miles south of the town of Bonham at an elevation of about 710 feet and flows in an easterly direction to the damsite which is situated at river mile 23.2 on the South Sulphur River (Forrest and Cotton, 1967, p. IV-1).

(c) The flood plains of the major branches of the Sulphur River are generally less than 2 miles wide. Normal floods do not inundate this area entirely but exceptional or record floods will. The width of the flood plain increases downstream to as much as 3 to 5 miles as the stream approaches the Red River in Miller County, Arkansas. In general, the drainage basin of the Sulphur River has become adjusted to the regional geology and may be considered to be in the late mature or early old age stage of development.

c. Structural geology. The surface rocks in the Sulphur River Basin lie in the northern part of a large regional structure termed the East Texas Syncline (see plate II-2). The beds dip to the south at rates of from 50 to 80 feet per mile. Only in limited areas does reversal of the regional dip occur. In the western part of the area, the regional east-west strike of the beds changes to the south or southwestward. The valley of the Sulphur River lies within one of the most intensely faulted areas in the Gulf Coastal Plain. The most prominent structures include the Luling-Mexia-Talco

fault zone, a narrow, well known system of normal faults, 5 to 10 miles wide, extending from Miller County, Arkansas, on the east to the vicinity of Commerce, Texas, on the west (see plate II-2). Near that point, the general trend of this fault zone changes, bending to the south and continuing for several hundred miles. Individual faults are rarely more than 15 to 25 miles long and within this narrow zone they intersect in an intricate pattern. The average vertical displacement along the faults is small, commonly less than 100 feet. The surface evidence of the faults is somewhat obscure, limited to visible linear changes in soil patterns and rarely offsets the outcrops (ETSU, 1971, page 92). In the subsurface, these faults are of major economic importance as they entrap petroleum and natural gas by stopping its updip migration. Faults increase in dimension with depth and, in some areas, have vertical displacement of several hundred feet at deeper horizons. These faults are no longer active, and no evidence of recent movement is recorded. The faulting is connected with long-term subsidence throughout the Gulf Coastal Plain, and is localized along the hinge line which separated the deepening Gulf of Mexico from the more stable continental shelf to the north. Although salt domes typically are associated with major faults in the coastal plain, no such structures are known within the river basin. However, salt structures do occur only a short distance to the south of this area, near Tyler in Smith County.

d. Geologic formations

(1) Regional surface geology of the Sulphur River basin. The exposed rocks of the Sulphur River Basin consist of a series of gently southward dipping layers of chiefly marine rocks. In the northern half of the basin, the rocks are Upper Cretaceous in age, and the rocks in the southern half of the area are Lower Eocene in age. The general strike of the outcrops is east-west with a southwest-northeast trend in the western part of the basin. Good exposures are not common. The less resistant layers are generally soil covered; however, along road cuts and some of the streams, particularly in the western half of the basin where more resistant rocks occur, good outcrops are available.

(2) Surface stratigraphy. The various formations which crop out in the Sulphur River Basin are listed and described in stratigraphic order, north to south, in order of age from older to younger (see tables II-1 and II-2). Recognition and correlation of these formations is based primarily upon the contained microfossils. The index microfossils and other common species which are indicative of the geologic formations below are listed in appendix

SYSTEM	SERIES	GROUP	FORMATION Northeast Texas	FORMATION Southwest Arkansas
QUATERNARY	HOLOCENE	---	Alluvium (Flood Plain Deposits)	Alluvium (Flood Plain Deposits)
QUATERNARY	PLEISTO-CENE	Terraces	Fluviatile Terrace Deposits (Terrace 1-5)	(Undivided)
TERTIARY	EOCENE	Claiborne	Sparta Sand	Undifferentiated
			Weches	
			Queen City Sand	
			Reklaw	
			Carrizo	
		Wilcox	Undifferentiated	Undifferentiated
	PALEO-CENE	Midway	Wills Point	Undifferentiated
			Kincaid	
CRETACEOUS	UPPER CRETACEOUS (GULF)	Navarro	Kemp	Arkadelphia Marl
			Corsicana Marl	
			Nacatoch Sand	Nacatoch Sand
			Neylandville Marl	Saratoga Chalk
		Taylor	Taylor Marl: Upper	Marlbrook Marl
			Taylor Marl: Pecan Gap	
			Taylor Marl: Wolfe City	Annona Chalk
			Taylor Marl: Lower	Ozan
		Austin	Austin Chalk: Gober Tongue	Brownstown Marl
			Austin Chalk: Blossom Sand	
			Austin Chalk: Bonham Marl	Tokio Sand
			Ector Tongue	

Generalized Stratigraphic Column for Surface Geologic Formations in the Sulphur River Basin - Northeast Texas and Southwest Arkansas

TABLE II-1

SYTEM	SERIES	GROUP	FORMATION Northeast Texas	 Southwest Arkansas
CRETACEOUS	UPPER CRETACEOUS (GULF)	Eagle Ford	Undifferentiated	Undifferentiated
		Woodbine	Undifferentiated	Undifferentiated
	LOWER CRETACEOUS (COMANCHE)	Washita	South Tyler Maness Buda Grayson Georgetown Subgroup	Undifferentiated
		Fredricksburg	Kiamichi Goodland-Comanche Peak Walnut	Undifferentiated
		Trinity	Paluxy Glen Rose: Rusk Rodessa James Pine Island Silgo Hosston	Undifferentiated
JURASSIC		Cotton Valley	Schuler Bossier	Undifferentiated
		Louark	Haynesville Smackover Morphlet	Undifferentiated
		Louann	Louann Werner	Absent

Generalized Stratigraphic Column for Subsurface Geologic Formations in the Sulphur River Basin - Northeast Texas and Southwest Arkansas

TABLE II-2

A, which is now on file at the New Orleans District; these fossils are foraminifera (microscopic protozoans) unless otherwise indicated.

(a) Cretaceous rocks

1. Bonham Marl. Exposed north of Paris; consists of clay and marl with sand content minor but increasing eastward; average thickness 375-530 feet. Marine origin.

2. Blossom Sand. Sandstone, nonresistant, with some thin beds of clay; average thickness 100-200 feet increasing to the east. Marine origin.

3. Brownstown Marl. Marl and clay; thickness 80-175 feet increasing to the east. Marine origin.

4. Gober Chalk. Chalky, nonresistant limestone; in upper 10 feet a resistant bed, the Roxton Limestone, is present; total thickness of the Gober chalk 300 feet, but it thins and disappears to the east in the vicinity of Detroit, Texas. Marine origin.

5. Ozan Formation. Clay with some sand; 400-425 feet thick. In the vicinity of Clarksville the Ozan is grouped with the Annona Chalk. Marine origin.

6. Annona Chalk. Thick-bedded chalk, 450 feet thick near Clarksville; thins to the west, merging with the Ozan and Pecan Gap Chalk. Marine origin.

7. Wolfe City Sand. Sand, nonresistant, with some sandy marl; thins to the east and disappears near Deport; thickness in the west 120 feet. Marine origin.

8. Pecan Gap Chalk. Weathers white, mainly nonresistant with some thin resistant layers; thickness 120 feet near the town of Pecan Gap but in the vicinity of Clarksville it is not separated from the Annona Chalk. Marine origin.

9. Marlbrook Marl. Soft clayey marl, thickness 150-450 feet; thins to east. Marine origin.

10. Neylandville Formation. Clay, some sandy layers, thickness 75 feet and present only in the western part of the basin. Marine origin.

11. Navarro Group. Mostly clay with increasing amounts of sand in the lower part, thickness 500-750 feet. Two members are recognized in the western part of the area, the Nacatoch Sand at the base, 200 feet thick, and the Kemp Clay at the top, 250-300 feet thick. Eastward, the Corsicana Clay is present between these two units. The Navarro Group is the youngest Cretaceous in the region. Marine origin.

(b) Eocene Rocks

1. Midway Group. Chiefly clay with a few thin beds of limestone; thickness from 500-600 feet. Two formations are mapped west of Sulphur Springs; these are the Kincaid Formation, clay with some thin limestones, thickness 150 feet; and, Wills Point Formation, clay with some thin beds of lignite, thickness 450 feet. Mixed marine and nonmarine origin.

2. Wilcox Group. Silty, sandy clay, thin local beds of lignite; abundant plant fossils; thickness 700 feet. Mixed marine and nonmarine origin.

3. Claiborne Group. This is the youngest Eocene strata exposed in the Sulphur River Basin. Only the Reklaw Formation and the Queen City Formation are found in the easternmost part of the drainage area. The Reklaw is sand and clay, about 50 feet in thickness. The Queen City consists of sandstone and thin beds of clay, with a total thickness of about 100-300 feet. Mixed marine and nonmarine origin.

(c) Quaternary Deposits. Fluviatile terrace deposits of Pleistocene age are present in places adjacent to the flood plain of the South Sulphur River. The Holocene flood plain deposits are principally silts and clays and the widths of the flood plain are generally from one-half mile to 3 miles wide. The thickness of the Holocene deposits ranges from only a few feet to a maximum of about 35 feet. These deposits have accumulated since the last stage of the Pleistocene.

(3) Subsurface geology of the Sulphur River Basin. Many thousands of feet of sedimentary rocks lie beneath the Sulphur River Basin. Southward dipping beds of both Upper Cretaceous and Lower Cretaceous age crop out north of the area, extending into southern Oklahoma and southwestern Arkansas. To the north, the total thickness of these exposed beds is as much as 2,500 feet. The strata are thicker in the subsurface, the older deposits (of

Jurassic age) are present at depths ranging from 8,000 to 10,000 feet below the surface (ETSU, 1971, page 90).

(a) The subsurface rocks of Upper Cretaceous age are chiefly shales and sandstones. The Woodbine Sandstone may be oil bearing in part of the area. Lower Cretaceous rocks include shales, thin beds of limestone, and beds of sandstone. The basal sandstones of the Lower Cretaceous, the Paluxy and Glen Rose, yield oil in several oilfields in the Sulphur River Basin.

(b) Beneath the Lower Cretaceous beds lies a thick wedge of shales, sandstones, and limestones of Jurassic age. These rocks are not exposed on the surface anywhere in the Gulf Coast region but have been penetrated by oil wells in Texas, Arkansas, Louisiana, and eastward to Florida. The Smackover Limestone of Jurassic age produces in several fields in the Sulphur River Basin at depths from 8,000 to 10,000 feet (ETSU, 1971, page 91). The probable northern limit of production from these deeper beds is very close to the general course of the Sulphur River. The fields are usually small, five to 10 wells, and the oil is trapped by faults which provide a barrier to updip migration. Most of the known fault traps have been tested in the area, and it is probable that no new major fields will be found in the future although additional small fields are likely to be discovered. There is significant potential for discovery of stratigraphic traps, though, to date, such features have been relatively unimportant. The Smackover and other formations contain layers of anhydrite and gypsum, and the oil and gas from these formations have a high sulphur content. In fact, some wells recover sulphur from the gas with a monetary value almost as high as that of the hydrocarbons.

(4) Local geology - proposed site of Cooper Dam. The proposed site is located within an area of gently rolling terrain with elevations of approximately 600 feet in the uplands, descending to 450 feet or less in the level areas, ultimately reaching about 400 feet on the flood plain at the proposed site. Three distinct physiographic units are recognizable: (a) the Cretaceous-Tertiary uplands, (b) the Pleistocene terraces, and (c) the Holocene alluvial plain of the South Sulphur River.

(a) The south abutment of the dam is to be located in a dissected hilly area underlain by relatively indurated sediments of Tertiary age (see plate II-3). The north abutment is to be positioned on a gently sloping terrace surface, which rises northward from an elevation near 405 feet at the edge of the flood plain and merges with the Cretaceous uplands north of Cooper. This

surface is dissected by the tributaries of the South Sulphur River. The north abutment is situated between Doctors Creek and Big Creek, two of these tributaries. The width of the alluvial plain at the proposed site is about 5,900 feet, widening downstream (Forrest and Cotton, 1967, page VIII-3).

(b) The sediments underlying the proposed site include the Marlbrook, Neylandville, and Kemp formations (Cretaceous age); Kincaid Formation (Tertiary age); Pleistocene terrace deposits; and Holocene alluvium. The Pleistocene and Recent (Holocene) sediments are shallow, superficial deposits which locally overlie the older strata along well established drainageways (see plates II-2 and II-3).

(c) Several faults of major proportions have displaced the strata in the damsite area. Some pass through or near the damsite itself (see plate II-3). The exact position and extent of these faults has been determined by detailed surface study, aided by inspection of samples from borings including the use of the microfaunal analysis of the sample for correlation purposes.

e. Economic geology. The major mineral resources in the Sulphur River area are petroleum and its associated products. About 25 to 30 producing oil and gas fields are situated within the drainage basin. Some consist of no more than two or three wells producing from a single interval, but one field has several hundred productive wells, and others produce from several different depths. The total value of the petroleum and gas produced in the area has reached several hundred million dollars. Individual wells have produced several million dollars worth of oil, gas distillate, or sulphur in a period of a few years. As mentioned previously, most of the production is localized along the Luling-Mexia-Talco fault zone, and prospects for future production and new discoveries are limited. The reported production of hydrocarbons in Hopkins and Delta Counties for the years 1968-1972 is summarized on the following pages (Texas Railroad Commission, 1973):

(1) Sand and gravel deposits provide an important commercial mineral resource in the area. These deposits generally are found in the Pleistocene terraces and along the river and small streams of the area. The deposits which are local in nature are usually less than 25 feet thick and are extremely variable in composition within short distances (Fisher, 1965, page 320). All deposits contain unwanted or deleterious materials, such as soft or highly weathered rock fragments, mud and clay balls, disseminated

PRODUCTION BY FIELD FOR HOPKINS COUNTY 1968-1972

YEAR	GAS WELL GAS MCF	CONDENSATE BBLS	CRUDE OIL BBLS	CASINGHEAD GAS MCF
BIRTHRIGHT FIELD (PALUXY)*				
1968	0	0	0	0
1969	0	0	0	0
1970	0	0	0	0
1971	0	0	0	0
1972	0	0	0	0
BIRTHRIGHT FIELD (SMACKOVER)*				
1968	0	0	320,834	994,108
1969	0	0	431,790	1,395,089
1970	0	0	172,566	609,801
1971	0	0	293,503	1,352,958
1972	0	0	336,288	1,991,958
BRANTLEY JACKSON FIELD (SMACKOVER)*				
1968	0	0	378,438	314,498
1969	0	0	500,882	497,517
1970	0	0	680,829	615,140
1971	0	0	693,847	707,793
1972	0	0	772,703	582,753
COMO FIELD				
1968	0	0	37,996	93
1969	0	0	31,087	78
1970	0	0	32,684	91
1971	0	0	30,816	101
1972	0	0	28,237	93
COMO FIELD (GLOYD)*				
1968	398,648	13,591	206	465
1969	258,805	10,641	0	0
1970	189,669	9,180	0	0
1971	113,337	5,829	0	0
1972	100,500	5,128	0	0

*Name of Producing Interval

YEAR	GAS WELL GAS MCF	CONDENSATE BBLS	CRUDE OIL BBLS	CASINGHEAD GAS MCF
COMO FIELD (MORRIS SAND)*				
1968	0	0	0	0
1969	0	0	0	0
1970	Field Name Changed to Como (Rodessa, Lo Hill)			
COMO FIELD (RODESSA LO HILL)*				
1968	0	0	5,173	8,251
1969		0	2,643	4,983
1970	0	0	3,090	5,292
1971	0	0	2,268	5,270
1972	0	0	2,114	3,794
COMO FIELD (RODESSA UPPER HILL)*				
1968	13,198	0	0	0
1969	0	0	0	0
1970	0	0	0	0
1971	0	0	0	0
1972	0	0	0	0
COMO FIELD (SMACKOVER)*				
1968	10,898,688	0	0	0
1969	7,866,207	0	0	0
1970	6,155,748	0	0	0
1971	6,057,336	0	0	0
1972	5,212,844	0	0	0
COMO FIELD (SUB-CLARKSVILLE)*				
1968	0	0	51,562	1,129
1969	0	0	40,913	80
1970	0	0	42,816	45
1971	0	0	34,581	91
1972	0	0	33,934	84
MITCHELL CREEK FIELD				
1968	0	0	13,445	24
1969	0	0	0	0
1970	0	0	1,755	14
1971	0	0	9,321	24

*Name of Producing Interval.

YEAR	GAS WELL GAS MCF	CONDENSATE BBLS	CRUDE OIL BBLS	CASINGHEAD GAS MCF
NELTA FIELD (SMACKOVER)*				
1968	0	0	0	0
1969	22,442	1,301	0	0
1970	997,530	58,391	0	0
1971	3,053,318	144,932	0	0
1972	3,949,108	147,054	0	0
PICKTON FIELD				
1968	0	0	29,408	650,475
1969	0	0	19,690	240,182
1970	0	0	0	0
PICKTON FIELD (BACON LIME)*				
1968	2,289,454	10,735	0	0
1969	1,370,767	6,246	0	0
1970	0	0	0	0
1971	0	0	0	0
1972	0	0	0	0
PICKTON FIELD (PINE ISLAND)*				
1968	0	0	15,275	12,035
1969	0	0	11,751	8,574
1970	0	0	9,750	8,163
1971	0	0	8,594	8,106
1972	0	0	7,618	7,361
REILLY SPRINGS FIELD (COKER)*				
1968	0	0	4,803	24
1969	0	0	4,408	24
1970	0	0	3,828	24
1971	0	0	3,776	24
1972	0	0	3,687	24
REILLY SPRINGS FIELD (SMACKOVER)*				
1968	0	0	181,570	271,024
1969	0	0	207,171	327,060
1970	0	0	160,528	264,101
1971	0	0	99,754	156,902
1972	0	0	57,353	192,487

*Name of Producing Interval.

YEAR	GAS WELL GAS MCF	CONDENSATE BBLS	CRUDE OIL BBLS	CASINGHEAD GAS MCF
SULPHUR BLUFF FIELD				
1968	0	0	480,162	1,427
1969	0	0	406,843	1,353
1970	0	0	367,571	1,389
1971	0	0	319,437	1,598
1972	0	0	278,332	1,548
SULPHUR BLUFF FIELD (SMACKOVER)*				
1968	292,923	10,586	0	0
1969	6	7	0	0
1970	0	0	0	0
1971	0	0	0	0
1972	0	0	0	0

SUMMARY OF PRODUCTION FOR 1968-1972 FOR DELTA AND HOPKINS COUNTIES

YEAR	GAS WELL GAS MCF	CONDENSATE BBLS	CRUDE OIL BBLS	CASINGHEAD GAS MCF
DELTA COUNTY				
1968-1972	NO PRODUCTION IN THIS PERIOD OF TIME			
HOPKINS COUNTY				
1968	13,599,988	10,735	1,140,434	2,253,529
1969	9,518,227	18,195	1,255,475	2,473,665
1970	7,342,947	67,571	1,638,932	1,588,102
1971	9,223,991	150,761	1,780,820	2,408,026
1972	9,262,452	152,182	1,820,754	3,077,547

*Name of Producing Interval.

clay or clay-coated particles, lignite, and other organic materials. Numerous small pits are located throughout the area. The largest and most productive area occurs in Bowie County, Texas, and in Miller County, Arkansas.

(2) No other major mineral resources are known in the area. Some rock quarries in the limestone beds of the northern part of the area furnish local sources of concrete aggregate and rough building stone. Some thin seams of lignitic coal usually found in Wilcox deposits may occur in the eastern part of the drainage area but are not of any major value.

f. Ground water. Ground water is the major source of the water used for domestic consumption and industrial purposes within the Sulphur River Basin. Of the annual precipitation falling in the area, about one quarter (10 to 11 inches) reaches the streams as runoff. The remaining three quarters are lost through evaporation, assimilated or respired in plant growth, or stored in subsurface aquifers. High stream flows are recorded in April and May, low flows in July and August.

(1) The depth to the ground water surface at nineteen localities in the Morris-Titus county area has been reported (ETSU, 1971). The average ground water level lies about 265 feet above mean sea level. The major sources of water are sandstones and unconsolidated sands ranging in age from Lower Cretaceous to Holocene. The yield of the aquifers varies with the thickness of the sands or sandstones, their permeability, their use, and the rate of recharge. Rock deformation also may affect water production by creating or blocking passages for flow of water through the aquifers. The principal aquifers (see table II-3) include the Paluxy, Woodbine, Blossom, and Nacatoch sandstones (Cretaceous age); Wilcox, Carrizo, Reklaw, and Queen City Formations (Tertiary age); and alluvial sands and gravels (Holocene age). Descriptions of these aquifers are presented in table II-3. The principal sources of fresh ground water in the study area are the formations of Tertiary age as listed above. These formations have similar hydrologic properties and are probably interconnected hydraulically. They function as a single aquifer, ranging in thickness from zero to about 1,200 feet and are generally known as the "Cypress Aquifer" (Broom, 1965, page 2).

(2) Sand comprises about half the volume of the aquifer, and the remainder is chiefly shale, clay, and silt with numerous lenses or beds of lignite [illegible]se sediments generally contain some iron bearing minerals with [illegible]ds, lenses, and nodules of

AQUIFERS SERVING THE SULPHUR RIVER BASIN

Aquifer	Geologic Age	Thickness and quality of Water
Paluxy-Trinity Sandstone	Lower Cretaceous	Stratum is up to 500 feet thick. Water of good quality at a depth of 3,300 feet near Ladonia; salt water in other parts of basin.
Woodbine Sandstone	Cretaceous	Stratum is up to 600 feet thick. Water of usable quality at western margin of basin but highly saline in the Commerce area.
Blossom Sandstone	Cretaceous	Stratum is up to 100 feet thick. Water fresh to slightly saline to depth of 350 feet; sodium carbonate content.
Nacatoch Sand	Upper Cretaceous	A series of sand layers up to 500 feet thick; sequence highly faulted. Water high quality near Commerce; more saline eastward.
Cypress (Includes Wilcox, Carrizo, Reklaw, and Queen City Formations)	Tertiary	Beds variable in thickness; positioned at the surface or at depths up to 1200 feet. Water quality highly variable.
Holocene	Holocene	Thickness variable; deposits alluvial in nature; producing depths variable. Quality of water variable.

(After East Texas State University, 1971)

Table II-3

limonite common at or near the surface. Due to these iron minerals, the water in the aquifer, occurring between a depth of 60 to 160 feet, has a high concentration of iron. The water above and below this zone contains little or no iron. The water below 160 feet is slightly alkaline.

(3) Pumping tests were performed in 18 wells tapping the Cypress aquifer in Camp, Franklin, Morris, Gregg, and Upshur Counties to determine the ability of the aquifer to transmit or store water (Broom, 1969, page 14 and Broom, 1965, page 27). The coefficient of transmissibility indicated by the data collected ranged from 170 to 11,000 gallons per day (gpd) per foot, a discharge rate ranging from 25 to over 800 gallons per minute (gpm), and specific capacities ranging from 0.4 to 15.5 gpm per foot of drawdown. The coefficient of storage obtained from three tests were 0.00006 and 0.00015. These values are within the range generally attributable to artesian conditions. Since none of the wells fully penetrated the aquifer, the results of tests generally gave values that are less than those values which would have been obtained from wells penetrating the entire aquifer.

(4) As indicated in table II-3, the quality of water from the Cretaceous aquifers is variable with a tendency to be saline or slightly saline. The quality of ground water within the alluvial deposits is variable and usually the quantity is small.

g. Unusual geologic features. The rocks of the Sulphur River Basin contain many marine invertebrate fossils. The strata of Eocene Age contain many large marine invertebrate fossils as well as microscopic forms. The fossil shells are more common in the limestones and marls. Fossil plants also have been found in some of the Eocene beds.

(1) In several localities in the region, remains of elephant tusks, skulls, and teeth have been found in the flood plains of the rivers. These animals lived in this region during the last stages of the Pleistocene glacial epoch, perhaps no more than 10,000 years ago.

(2) Archeologists have collected artifacts that indicate man has occupied or traversed the Sulphur River Basin since the last stages of the Pleistocene Epoch (ETSU, 1971, pages 50-84). Numerous sites have been located along the edge of the lowest Pleistocene terrace and on knolls in the alluvial flood plain. The terrace provided a habitat located just above high water and flood levels within easy access to water. Artifacts found in these sites

indicate that gravels from the upland terraces provided the raw materials for tools (ETSU, 1971, page 84).

(3) No destructive earthquakes have occurred in historic time in the Sulphur River Basin. Several earthquakes of moderate intensity have been recorded in the area in the past 50 years, but this does not indicate evidence of recent movement along the Luling-Mexia-Talco Fault Zone. The probability of several damaging earthquakes or even minor shocks in the Sulphur River area is considered to be very low. The region is a very stable seismic area (ETSU, 1971, page 98).

2.03 HYDROLOGIC ELEMENTS

a. General hydrology of total study area. The Sulphur River drainage basin is an elongated east to west oriented area, approximately 150 miles in length from its confluence with the Red River in Miller County, Arkansas, to the headwaters near Leonard, in Fannin County, Texas. The basin has a maximum width of 45 miles between Blossom, Texas, on the north and Pickton, Texas, on the south. It will average about 25 miles in width, thus draining an area of approximately 3,700 square miles. North and east of the basin the drainage is into the Red River, to the west the drainage is into the Trinity River, and to the southwest the drainage is into the Sabine River. The main stem of the Sulphur River divides at the five corner meeting of Franklin, Red River, Hopkins, Lamar, and Delta Counties into the North Sulphur and South Sulphur Rivers. Two sizeable tributaries join the Sulphur River, Cuthand Creek from the north, and White Oak Bayou from the south. Both of these creeks enter the river about midway of its course. Many smaller creeks are also tributary to the Sulphur River and its main tributaries.

b. Hydrology of project area. The proposed Cooper damsite, located on the South Sulphur River at mile 23.2, would control runoff from a drainage area of 476 square miles, about 73 percent of the total South Sulphur River watershed. The damsite is located in the northeastern part of the State of Texas in Delta and Hopkins Counties, about 15 miles upstream from the confluence of the North and South Sulphur Rivers. The watershed extends in a westerly direction from the damsite for a distance of about 38 miles.

(1) Major tributaries. The watershed has two principal drainage systems, the Middle and the South Sulphur Rivers. Above their confluence, the Middle Sulphur River has a drainage area of 133 square miles and the South Sulphur River, 208 square

miles. Between that confluence and the damsite is a drainage area of 135 square miles.

(a) The Middle Sulphur River rises in Fannin County near the Fannin and Hunt county line at an elevation of 680 feet above mean sea level (m.s.l.) and flows in a southeasterly direction for about 35 miles, where it joins the South Sulphur River. The South Sulphur River also rises in Fannin County west of the headwaters of the Middle Sulphur River, about 10 miles south of Bonham, Texas, at an elevation of about 710 feet, m.s.l. The South Sulphur River flows in a southeasterly direction for about 22 miles and thence in a northeasterly direction to the damsite.

(b) The Sulphur River, formed from the confluence of the North and South Sulphur Rivers, flows easterly, following a meandering course for about 153 miles, into Wright Patman Lake. Wright Patman Lake controls a drainage area of about 3,400 square miles, has a conservation storage of 145,300 acre-feet and a flood control storage of 2,509,000 acre-feet. The major tributaries of the Sulphur River are the South Sulphur River (650 square miles), North Sulphur (438 square miles), Mustang Creek (65 square miles), Cuthand Creek (374 square miles), and White Oak Bayou (773 square miles). The North and South Sulphur Rivers join to form the Sulphur River at mile 197.3. Mustang Creek enters at mile 177.2, Cuthand Creek at mile 145.8 and White Oak Bayou at mile 107.4 on the Sulphur River.

(2) Channel characteristics. Stream bed elevations vary from approximately 710 feet m.s.l. in the western headwater section of the South Sulphur River drainage area to 386 feet m.s.l. at the Cooper Dam site and 190 feet m.s.l. at Wright Patman Dam. The average stream slope above Cooper Dam site is 4.6 feet per mile. The slopes of the North and South Sulphur Rivers above their confluence vary from 1.3 to 5 feet per mile. The Sulphur River has a slope of approximately 1.2 feet per mile from the confluence of the North and South Sulphur Rivers to mile 122 and 0.5 feet per mile from there to Wright Patman Dam. The channel capacity of the South Sulphur River in the vicinity of the Cooper Dam site is 2,200 cubic feet per second (c.f.s.). Channel capacities of the North Sulphur and Sulphur Rivers at selected gaging locations are 40,000 c.f.s. near Cooper (mile 14.3) on the North Sulphur, 5,880 c.f.s. near Hagansport (mile 187.7), 4,500 c.f.s. near Talco (mile 173.4) and 4,800 c.f.s. near Darden (mile 104.7) on the Sulphur River.

(3) Sediment. The South Sulphur River discharges approximately 140 acre-feet of sediment into the Sulphur River each

year. This estimate is based on suspended sediment data taken near Cooper, Texas, and an annual flow of 275,300 acre-feet. The Sulphur River carries approximately 1,360 acre-feet of sediment a year into Wright Patman Lake, based on data taken near Darden, Texas, and an annual flow of 1,670,000 acre-feet.

(4) Water quality

(a) General. Chemical properties of the surface flow are affected by the soils characteristics of the area, patterns and characteristics of streamflow, and the activities of man. In time of high flow the increased surface runoff tends to dilute the reappearing ground water which could be mineral enriched. At such times the water normally remains of high quality, aside from the increased sediment load. During low flow the ground water could be reentering the surface water which results in higher concentration of dissolved solids. This can result in the degradation of water quality. In most streams where the flow is not modified by upstream reservoirs, the dissolved mineral constituents vary inversely with the stage of the stream. This relationship is generally applicable to the Sulphur River. Table G-1 (appendix G) is a summary of the water quality recorded at the gaging station on the South Sulphur River near Cooper, Texas. In order to simplify the table, only the average concentration of the substance is recorded for each water year. Table G-2 (appendix G) is a summary of the possible sources for the various substances which were found in the water. The significance of the presence of each impurity is also outlined in that table. One final measure of the quality of the surface water is its ability to support life. Table G-3 (appendix G) gives the results of 2 years of sampling by the Texas Water Development Board for biochemical oxygen demand, dissolved oxygen, and pesticides. The Texas data network for measuring these quantities was established in January 1968 (Texas Water Development Board, 1968). Biochemical oxygen demand (BOD) is an indicator of the amount of oxygen required by aerobic bacteria while stabilizing decomposable organic matter. Dissolved oxygen (DO) is the amount of oxygen dissolved in water and is one of the most important indicators of the biological, chemical, and sanitary quality of the water.

(b) Water uses and wastewater discharges. Water in the Sulphur River above Wright Patman Lake, including the North, Middle, and South Sulphur Rivers is known to be used for noncontact recreation, propagation of fish and wildlife, domestic raw water supply, and irrigation. Water for these purposes meets the criteria

revised by the Texas Water Quality Board in February 1976. Specific water quality standards for the Sulphur River, proposed by the Texas Water Quality Board (Texas Water Quality Board, 1973) are as follows:

Cl	Average not to exceed	100 mg/l
SO_4	Average not to exceed	100 mg/l
TDS	Average not to exceed	500 mg/l
DO		>5.0 mg/l
pH range		6.0 - 8.0
Fecal Coliform		2000/100 ml
Temperature	maximum	93^{o} F
	maximum difference	5^{o} F rise over ambient

Known wastewater discharges in the North, Middle, South, and Sulphur River drainages are listed in table G-4 (appendix G). All the industries shown were issued permits from the Corps of Engineers under the Refuse Act Permit Program (RAPP). Although treatment is provided in practically all cases, pollutants in discharges from industries could be indicative of the types carried in the water and/or deposited in the sediments above Lake Wright Patman.

(c) Water quality and sediment data

1. Water quality data collected by the Corps of Engineers during November 1974 are exhibited in table G-5 (appendix G) and are used to characterize the upstream surface runoff. The locations of the stations follow:

Station	Location
16060	South Sulphur River near Commerce, Texas
16090	Middle Sulphur River at Commerce, Texas
16110	Middle Sulphur River 1.4 miles north of Horton, Texas
16120	South Sulphur River near Cooper, Texas
16510	Sulphur River near Naples, Texas
16540	Sulphur River near Douglasville, Texas

2. Preliminary water and sediment data has been provided by the Texas Water Quality Board for Wright Patman

Lake. These data are exhibited on table G-6 and G-7 (appendix G). The station locations are as follows:

Station	Location
1	Reservoir - River Channel near dam
2	Reservoir - River Channel in Elliot Creek Arm
3	Reservoir - River Channel in Big Creek Arm
4	Reservoir - River Channel near Webster Creek Cove
5	Reservoir - River Channel above Highway 8 Bridge

Water quality data indicate that most of the parameters tested are within the acceptable limits for public water supply intake recommended by EPA, which are given in table G-8 (appendix G). The values for lead (Pb) and cadmium (Cd) are reported as less than 0.200 and 0.050 mg/l, respectively, and their acceptable limits are 0.05 and 0.01 mg/l, respectively. The data for Pb and Cd given on table G-5 (appendix G) cannot be assessed with respect to EPA's recommended criteria. The only parameter in table G-5 or G-6 (appendix G) which exceeds EPA criteria is Iron (Fe). Concentrations of Fe were reported greater than 0.3 mg/l at stations monitored by the US Corps of Engineers, which are located upstream from Wright Patman Lake. It is most probable that the high concentrations of iron are derived from natural sources. Possibly the best evidence of what type of pollutants exist upstream from Wright Patman Lake is the analysis of the lake sediment presented in table G-7 (appendix G). Many of these sediment constituents may be derived from man's activities at upstream locations although they can exist naturally. Values given for COD, Kjeldahl nitrogen, volatile solids, and oil and grease at stations 2, 3, 4, and 5 indicate that most oxygen-demanding materials settle in the bays created by the major tributaries. This trend is also exhibited by the results reported for heavy metals, although pesticides were in most instances not detected. The smallest concentration was usually at Station 1. Sediment criteria related to dredging activities are shown on table G-9 (appendix G) and are used here to indicate pollutional strength of the lake sediments. Arsenic (As) was reported as 5.4 mg/kg at Station 2 which exceeds the recommended criteria of 5.0 mg/kg. The criteria for zinc (Zn) is 75 mg/kg, which was exceeded at stations 4 and 5 with concentrations of 77 and 82 mg/kg, respectively. Chemical Oxygen Demand (COD) and Total Kjeldahl Nitrogen (TKN) at most stations exceed the maximum allowable values of 50,000 and 1,000 mg/kg, respectively. Of the parameters existing in high concentrations in either the water or

sediments (i.e., Fe, As, Zn, COD, and TKN), the one most commonly associated with high concentrations in soils is Fe. This is evident from the high concentrations of Fe reported at the stations monitored by the Corps of Engineers upstream from Wright Patman Lake. The data presented in table G-10 (appendix G) represents the dissolved oxygen (DO) content, temperature, conductivity, alkalinity, and pH of measurements taken at Stations 1, 2, 3, and 5 at Lake Wright Patman. The DO and pH profiles indicate that the dissolved Fe which is carried into the lake by its upstream tributaries is readily oxidized. This was apparent at all measured depths of Stations 1, 2, 3, and 5 from the high DO values and pH values greater than 6.0.

3. Sediment data collected by the Corps of Engineers on 12 March 1976 on the Sulphur River are shown in appendix G, tables G-11 through G-19. Locations of the sampling sites are shown on plate II-4. Sample number 1 (table G-11) failed EPA Region VI bottom sediment criteria only for total Kjeldahl nitrogen. This was the only sample out of nine to have any parameters fail this sediment criteria.

(d) Elutriate Test Results. In addition to the sediment analyses performed on the 12 March 1976 Sulphur River samples, the Standard Elutriate Test was also performed. The results are also shown in appendix G. A comparison of the elutriates to applicable water quality criteria (recommended EPA water quality criteria for public water supply intake in table G-8) reveals that only one elutriate value for manganese exceeded the recommended EPA criteria.

(5) Stages and discharges. Maximum recorded stages vary from 481.34 feet m.s.l. on the Middle Sulphur River near Commerce, Texas, to 258.17 feet m.s.l. on the Sulphur River near Naples, Texas; the mean annual high water at the former location is 478.82 feet m.s.l. and the mean annual low water is 465.99 feet m.s.l. The Sulphur River station near Naples, Texas, has a mean annual high water of 249.67 feet m.s.l. and a mean annual low of 221.88 feet m.s.l. Discharge data for major gaging stations in the basin are shown in table II-5. Flows within the Sulphur River Basin consist primarily of runoff, with small, intermittent contributions by springs and seepage. The general flow characteristics are best reflected by streamflow records from discharge ranges located at South Sulphur River near Cooper and Sulphur River near Naples, Texas. A table of mean monthly flows of the South Sulphur River near Cooper, Texas, gage are furnished in table II-4. The Cooper gage is 3.9 miles downstream from the authorized Cooper Dam site, at mile 19.3 of the South Sulphur River. The average flow

at that location during the 30-year period of recording ending in 1972 was 380 c.f.s., or about 9.79 inches of runoff per year from the watershed. The maximum discharge was 42,500 c.f.s. on 10 December 1971; zero flow was experienced during a 4.5-month period in 1956. Maximum and minimum values of total annual runoff are, respectively, 834,870 acre-feet in 1957 and 51,910 acre-feet in 1956. The average discharge at the Naples range (Sulphur River mile 104.7; drainage area 2,774 square miles) from the 31-year period ending in 1954 is 2,400 c.f.s. per annum, or about 11.74 inches of runoff from the watershed per annum. The maximum discharge recorded at this range is 157,000 c.f.s. on 1 April 1945; zero flow was experienced occasionally. Maximum and minimum values of annual runoff are 4,155,000 acre-feet in 1945 and 407,900 acre-feet in 1936, respectively. Extremes of discharges of the Sulphur River and major tributaries within the basin are listed in table II-5.

Table II-4

Mean Monthly Flow of South Sulphur River near Cooper, Texas[a]
(c.f.s.)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
381	628	516	739	834	465	189	32.4	226	276	406	434

[a]Flows at the dam location can be estimated by applying factor of 90 percent to the above figures.

(6) Floods. The Sulphur River and its tributaries are subject to frequent flooding which may occur in any season of the year. Channel rectification, carried out 47 years ago along practically the entire length of North Sulphur River, and subsequent erosional enlargement of the channel have practically eliminated agricultural damages by flooding along the North Sulphur River. The enlarged channel has reduced the concentration time of storm runoff to the extent that peak discharges on this river are now materially greater than those experienced on the South Sulphur River, even though its watershed is much smaller. Peak stages and discharges for the major floods that have occurred during the period of record within the Sulphur River watershed are shown in table II-6.

(7) Climatology

(a) Temperature. Summers are usually long and hot, while winters are usually short and moderate. The average

Table II-5

SULPHUR RIVER BASIN
FLOW DATA

STATION	Maximum Discharge (c.f.s.)	Date	Minimum Discharge (c.f.s.)	Date	Average Discharge (c.f.s.)
South Sulphur River near Cooper, Texas	42,500	10 Dec 71	0	23 Sep 72 (b)	380
North Sulphur River near Cooper, Texas	90,600	19 Oct 71	0	24 Sep 72 (b)	238
Sulphur River near Talco, Texas	77,000	11 Dec 71	0	4 Dec 56 (b)	1,386
near Naples, Texas	157,000	1 Apr 45	0	31 Jul 72 (b)	2,400
Cuthand Creek near Bogata, Texas	20,400	10 Dec 71	0	31 May 72 (b)	59.1
White Oak Bayou near Talco, Texas	48,000	11 Dec 71	0	29 Sep 72 (b)	405

(b) And earlier dates.

Source: Water Resource Data for Texas (U.S.G.S.)

Table II-6

MAJOR FLOODS DURING PERIOD OF GAGE RECORDS

ON SULPHUR RIVER WATERSHED

Date		South Sulphur River nr. Cooper (527 mi^2)		North Sulphur River nr. Cooper (276 mi^2)		Sulphur River nr. Talco (1,365 mi^2)	
		Stage (ft)	Discharge (c.f.s.)	Stage (ft)	Discharge (c.f.s.)	Stage (ft)	Discharge (c.f.s.)
January	1938					35.40	92,000(1)
May	1944	20.40	13,000				
March	1945	21.50	16,400			37.56	157,000(1)
November	1946	21.02	14,800				
January	1949	20.60	13,600				
February	1950	22.09	18,300	23.15	32,000	31.27	51,100(1)
September	1950	20.16	12,300	22.36	31,900		32,600(1)
April	1952	20.49	13,300	21.15	30,800	31.45	54,400(1)
April	1953	23.00	23,800	25.86	42,800	30.70	47,000(1)
May	1954	18.01	6,100	20.13	28,000	29.56	36,000(1)
February	1956	13.70	1,720	21.80	32,300		
April	1957	22.37	23,200	22.50	39,800	23.63	32,900
May	1957	21.19	18,400	22.30	30,200	23.02	[illegible]
November	1957	22.36	23,200	20.90	35,800	24.60	44,900
May	1958	20.93	17,400	22.35	39,500	25.69	[illegible]
June	1959	-	-	20.00	35,700	22.85	21,900
July	1959	15.63	3,310	19.25	33,600	22.55	[illegible]
December	1959	19.83	13,600	15.90	25,500	23.70	31,600
December	1960	18.69	10,300	-	-	23.65	30,500
March	1961	-	-	18.30(2)	33,000	23.43	28,300
June	1962	-	-	12.30(2)	16,500	-	-
September	1962	19.31	12,100	-	-	22.43	15,300
November	1962	18.48	9,700	18.13(2)	32,400	23.57	30,500
November	1964	17.60	8,800	18.40(2)	22,100	22.66	19,400
February	1965	21.47	25,000	27.00(2)	48,000	25.46	49,000
May	1965	20.49	20,000	24.06(2)	38,400	23.69	31,600
April	1966	23.02	30,500	22.74(2)	40,800	26.40	56,600
May-June	1967	21.58	25,500	27.00(2)	47,500	25.77	50,200
October	1967	18.08	10,600	16.86(2)	21,100	23.52	28,700
March	1968	18.74	12,800	23.38(2)	37,100	23.58	29,600
May	1968	17.77	9,540	-	-	23.34	26,700
June	1968	-	-	20.59(2)	30,000	23.42	27,700
January	1969	21.57	25,500	28.05(2)	50,500	26.14	53,300
May	1969	22.77	31,500	29.00(2)	54,000	26.25	54,000
April	1970	18.95	14,000	24.70(2)	40,700	24.40	29,600
October	1971	24.94	33,000	36.16(2)	90,600	26.30	46,000
December	1971	26.15	42,500	34.30(2)	64,300	29.40	77,000

(1) At Harden Station.

(2) Zero of gage lowered 4.0' on 21 May 1960. Values shown have been adjusted to datum used prior to change.

(3) Notes:

(a) Blank spaces - no gages were in place during these periods.

(b) Dashes - the storm was concentrated only over the North Sulphur or South Sulphur River watersheds.

Source: Cooper Lake and Channels, Alternative Plan Studies, URS/Forrest and Cotton, Inc. ([illegible])

annual temperature in this area is 64 degrees F, ranging from 83 degrees F during July to 44 degrees F during January. Extreme temperatures vary from 118 degrees F to -13 degrees F. The growing season is about 8 months in duration with the first and last killing frosts usually occurring about the middle of November and March, respectively.

(b) Rainfall. Average annual rainfall over the drainage area above Wright Patman Lake is about 44 inches, varying from an average of 47 inches at the damsite to about 40 inches near the upper limits of the basin. The extreme annual precipitation varies from 109.4 inches to 12.7 inches. Maximum precipitation usually occurs in March, April, and May, while the minimum usually occurs in August and September.

(c) Snowfall. Snowfall occurs over the basin about one to four times a year but rarely remains on the ground more than a few days at a time. The average annual snowfall depth is about 3 inches.

(d) Evaporation. Maximum evaporation generally occurs during the months of July and August, while the minimum evaporation is experienced in December and January. The average annual pan evaporation at Daingerfield is 74 inches with an average monthly minimum of 2.5 inches in December and January, and an average monthly maximum of 9.5 inches in July and August. The mean relative humidity averages 71 percent at Texarkana and Shreveport and 64 percent at Dallas. During the summer months the humidity ranges from an average of 90 percent during the early mornings to about 50 percent in midafternoons.

(e) Wind. At Texarkana, Arkansas, there is an average wind velocity of 8.4 m.p.h. predominately from the northeast. At Shreveport, the annual mean wind velocity is 8.2 m.p.h., prevailing from the southeast. Seventy-two percent of the Texarkana readings and 68 percent of the Shreveport readings fall into the 4-12 m.p.h. grouping.

(8) Extent and character of flooded area. Economic losses sustained during floods along the Sulphur River are agricultural or rural in nature. Flooded areas for the 15- and 30-year floods are as follows:

Flooded Area Acres	15-Year	30-Year
Wooded	57,000	58,000
Semiwooded	12,000	12,300
Cleared	18,800	18,900
Total	87,800	89,200

2.04 BOTANICAL ELEMENTS

a. Basin characteristics

(1) General. The Sulphur River basin extends over 11 Texas counties and one Arkansas county. The watershed includes three major vegetational areas, Pineywoods, Post Oak Savannah, and Blackland Prairie, which occur in broad belts across the drainage basin and are controlled by the diversity of soil types present from east to west over the area. The total forest area within the basin covers approximately 608,000 acres, much of which is included in a rather narrow band of flood plain along the Sulphur River. The flood plain rarely reaches 1 mile in width. Table II-7 shows the distribution of forest types among the counties within the Sulphur River basin.

(a) Piney woods. The piney woods area is on the easternmost fringe of the basin and extends into Arkansas and Louisiana. The forests are predominately pine (152,000 acres) and pine-hardwood (107,000 acres) and are restricted to the acid upland soils bordering the flood plain. Loblolly and shortleaf are the major pine species, although planted forests of slash pine are common on abandoned cropland. The hardwood species consist of various oaks, hickories, sweetgum, blackgum, elms, and numerous minor tree species, principally in the understory. The overstory canopy is partially open and generally the understory is dense with various shrubs, small trees, and vines. The forest floor is heavily shaded and supports a sparse cover of herbaceous vegetation. The grasses are generally used as natural forage for cattle grazing. These include numerous species of *Panicum* and *Paspalum* which are often replaced by broomsedge, smutgrass, and yankeeweed when overgrazing occurs. The Pineywoods forest area has the greatest economic potential for commercially harvestable timber within the basin.

(b) Post Oak Savannah. The Post Oak Savannah area lies in the central portion of the basin, restricted to the

Table II-7

Forest Types in Sulphur River Drainage Basin

	Forest Types[a] (Acres)			
County, State	Pine	Hardwood	Pine-Hardwood	Total
Bowie County, Texas	28,015	86,908	28,016	142,939
Cass County, Texas	21,676	36,216	11,764	69,656
Delta County, Texas	-	14,441	-	14,441
Fannin County, Texas	-	1,234	-	1,234
Franklin County, Texas	3,795	11,387	15,182	30,364
Hopkins County, Texas	-	68,600	-	68,600
Hunt County, Texas	-	1,236	-	1,236
Lamar County, Texas	-	-	-	28,390
Morris County, Texas	10,915	6,560	10,915	76,972
Red River County, Texas	16,272	53,303	7,396	76,972
Titus County, Texas	-	51,804	11,954	63,758
Miller County, Arkansas	71,695	16,545	22,060	110,300
Total	152,368	348,234	107,287	607,890

[a]Forest types with no acreage values (-) indicates that this type does not occur enough to be considered significant. Source: Adapted from East Texas State University (1971).

slightly acid claypan soils which extend across the region. The woody vegetation is primarily an oak-hickory complex considered by some authorities to be an extension of the Eastern Deciduous Forest (Braun, 1950). The upland forests consist mainly of post oak and blackjack oak with hickories and other hardwood species. Overstory canopy coverage is sparse to medium in density and many brush and tall grass species are usually abundant in the understory layers. The area has been consistently used for grazing of native grasses; however, conversion to improved pastures is the general trend. The woods have limited commercial importance, primarily for posts, cross ties, and firewood.

(c) Blackland Prairie. The western part of the Sulphur River basin extends into the Blackland Prairie vegetational area. This is an open grassland community virtually free of trees except in the stream areas. The soils are alkaline to slightly acid clays, generally fertile, and productive. Areas which have not been subjected to heavy grazing or mismanagement support native grasses such as little bluestem, big bluestem, Indian grass, side-oats grama, hairy grama, tall dropseed, silver bluestem, and Texas wintergrass (Gould, 1975). Much of the area, however, has been brought under cultivation and/or converted to tame pasture.

(2) Forest trends. The total woodland in the Sulphur River basin shows an increase from 688,000 acres in 1940 to 928,000 acres in 1950, and then a gradual decrease from 1950 to 718,000 acres in 1964. Woodland utilized for grazing increased by approximately 70,000 acres to a total of 610,000 acres during this time. This can be explained by the transition from a primarily agrarian economy centered on harvestable crops to one stressing livestock grazing. Although cotton has been the major cash crop in the area since the mid-nineteenth century, none of the counties in the basin rank in the top ten in Texas cotton production.

(3) Agricultural trends. Significant changes in farm management programs began occurring when soils became depleted from overuse in a one-crop economy as with cotton. Croplands utilized specifically for improved pastures have almost doubled in the past 30 years, reaching in excess of 711,000 acres. Accordingly, croplands from which agronomic crops are harvested have declined in area by more than half during this period. Currently, approximately 670,000 acres of land are utilized for growing crops, but this is less than the present acreage of cropland delegated to improved pastures. These figures indicate an increase in the total land area pastured; i.e., woodland and grassland. However, the

regional trend toward developing improved pastures far exceeds the usage of unimproved croplands and woodlands for grazing.

b. Flood plain characteristics

(1) General. The area for which improvements are proposed involves approximately 90,000 acres in the Sulphur River flood plain and the uplands surrounding Cooper Lake. Appendix B, which is on file at the New Orleans District, contains a list of the species known to occur in this area. Presently, 60,000 acres of this area are wooded or semiwooded and 30,000 acres are cleared. The woodlands are mainly stream forest types in the river flood plain.

(2) Flood plain vegetation. During 1971 scientists from East Texas State University made a survey of vegetation within the Sulphur River flood plain and selected tributaries. The objective of this survey was to identify the dominant woody and nonwoody plant species and to note the occurrence of threatened and/or endangered species in the proposed improvement area. The survey was conducted by Dr. Evan P. Roberts, Professor of Biology, East Texas State University, and six assistants. Eighteen collecting sites (refer to plate II-5) were selected in a manner to insure a sufficient number of locations within each of the vegetative areas of the basin. The method of collecting specimens consisted of the team going to each site at the river bank and separating from each other a distance of 25 yards. Each member of the team proceeded 100 yards from the river. All types of higher plants were recorded within this 17,500 square yard area at each location. Plants from each location were dried, pressed, identified, and remain in the East Texas State University herbarium. The species checklist is presented in appendix B, which is now on file at the New Orleans District.

(a) General. In its natural state the Sulphur River flood plain varied in width from 1 to 2 miles (East Texas State University, 1971). The area was primarily forested, but as previously cited, much of the flood plain was cleared, providing valuable agricultural land for crop and livestock production. The soils are clayey alluvium mainly of the Gladewater-Kaufman association. They are frequently flooded, poorly to somewhat poorly drained, very slowly permeable, neutral to slightly acid clays. Less clayey, better drained soils occupy riverfront and low ridge positions in the landscape.

(b) Overstory. Present vegetation patterns within the flood plain are controlled by microsite variation in the

landscape, principally soil drainage and man-made disturbances associated with land clearing and agricultural practices. Major forest sites include new land or riverfront along present or recent drainage channels and the ridges, flats, sloughs, and swamps in the flooded areas behind the riverfront.

1. Riverfront. Riverfront habitats include the most recent alluvial depositions. The soils are often sandy, moderately well-drained, and with little profile development. Plant species are pioneer types which include cottonwood, boxelder, hackberry, willow, and white ash. These species have phenomenal growth rates and fair commercial value. Distribution of the type, however, is restricted in area, thus reducing commercial importance.

2. Sloughs and swamps. Behind the riverfront on the low ridges and flats, the forest type consists primarily of hackberry, white ash, and elm species. Other common trees include bitter pecan, water oak, willow oak, hickory species, post oak, black oak, Shumard's red oak, boxelder, and black locust. More poorly drained flats support cedar elm, bitter pecan, willow oak, hackberry, and locust. The quality and commercial value of these species is generally low and their use is restricted locally for firewood, posts, and low grades of lumber.

(c) Understory. Understory woody plants show similar responses to microsite variation in the landscape. Frequent species include dogwood, hawthorns, possum haw, American beautyberry, swamp privet, red bud, red cedar, and various vines. Generally the understory is sparse due to frequent flooding.

2.05 ZOOLOGICAL ELEMENTS

a. General. The environmental inventory prepared by East Texas State University (1971) revealed a total of 1,234 animal species occurring in the Sulphur River Basin. These include 123 species of benthic macroinvertebrates, 84 species of fishes, 45 species of reptiles, 43 species of amphibians, 602 species of insects, 295 species of birds, and 42 species of mammals. Appendix C, which is now on file in the New Orleans District office, includes a checklist of the fauna identified in the inventory.

b. Benthic macroinvertebrates

(1) A checklist of the benthic macroinvertebrates was prepared by Dr. John H. Carroll, Department of Biology, East Texas State University (East Texas State University, 1971). The samples utilized to compile the checklist were taken with an Ekman dredge

at the locations indicated in plate II-5. In most cases the organisms were identified to family and generic levels only since specific identification is extremely difficult for such groups as midges, mollusks, and oligochaetes. The larval stages of numerous insects such as the mayflies, midges, dragonflies, caddisflies, and mosquitoes are highly dependent on the water bottoms for their development. Such organisms as crayfish, leeches, worms, amphipods, freshwater prawns, and aquatic insects are closely associated with the benthic environment. Freshwater mussels are much less mobile and are generally restricted to a rather sedentary existence on the river and creek bottoms. Although many of these organisms are predatory on other smaller invertebrates, the majority of all aquatic invertebrates constitute important forage in the diet of smaller predaceous fishes.

(2) Duncan (1971) collected benthic samples at nine stations on the South Sulphur River for almost a year. Six of the nine stations were on unchannelized portions of the river, and three stations were on channelized portions. The greatest number of species (25) were collected in a sample from a channelized segment of the South Sulphur River, while the lowest number of species (13) collected in one sample came from a station located on an unchannelized portion of the river. Seasonal variations in numbers of species were noted, with highest numbers from unchannelized portions of the river in winter; whereas, the greatest number of species were recorded from channelized portions of the river in the spring. Throughout the study, a total of 46 species were collected from unchannelized stations, while 39 species were collected from channelized stations. In addition, channelized segments showed an overall reduction (approximately 20 percent) in total number of organisms when compared to unchannelized portions of the river.

c. Insects and close allies. The insects are the most numerous of all invertebrates in the basin. Many of them are considered beneficial to man and his endeavors in that they enhance his agronomic successes by assisting in pollination and by predaceous or parasitic control of many agricultural pests. Some insects and allied groups, especially ticks and mites, are quite pestiferous. The bottomland hardwood-riverine habitat is especially conducive to the production of abundant populations of insects and their allies which act as vectors. A vector is considered to be any species which transmits disease organisms to higher animals, especially man, or which affects man's comfort, mental composure, and economic welfare. Due to their large populations and extensive species diversity, mosquitoes probably pose the greatest vector problems in the basin. Of less significance are the vector roles

of deerflies, horseflies, biting midges, and ticks. Some of the diseases transmitted by these groups include malaria, yellow fever, dengue, filariasis, tularemia, cattle fever, and viral encephalides. A checklist of the insects identified throughout the Sulphur River Basin was prepared by Dr. E. Fred Klaus and Dr. Robert K. Williams, Department of Biology, East Texas State University (East Texas State University, 1971). Due to the absence of checklists for the area, only insects personally identified from on-site collections and collections available in the entomology laboratories of East Texas State University were used.

(1) Dr. Fred Klaus (telephone conversation on 26 August 1976) provided additional information concerning his observations on the relative abundance and significance of various vectors. He indicated that of the 85 or more species of mosquitoes found in the basin, the predominant ones included *Culex quinquefasciatus*, *Culex tarsalis*, *Aedes vexans*, *Psorophora* sp., *Anopheles quadrimaculatus*, and *Anopheles punctipennis*. He stated that large tick populations and swarms of horseflies, deerflies, houseflies, and biting midges often prove to be a great annoyance in the area. He pointed out, however, that the greatest threat of disease transmission probably comes from mosquitoes and ticks. Although each of the various vectors exhibit peak densities during various times of the year, annual surveys and collections in the project area indicate that overall population sizes are moderate. Generally, variations in population densities are weather dependent. The project area has a history of erratic, undependable rainfall patterns. There are periods when the only water available is confined to deeper ground pools and oxbows. This factor severely limits populations of water-dependent species such as mosquitoes.

(2) Mr. Bobby Davis, Entomologist, Vector Control Division, Texas State Department of Health, Austin, indicated that although diseases such as tularemia and cattle fever, both vectored by ticks, are real health problems, greater risks are posed to public health by diseases vectored by mosquitoes (telephone conversation on 26 August 1976). Health records in the state reveal that strains of viral encephalides such as St. Louis equine and eastern equine are reported from the project area; however, no Venezuelan equine encephalitis has yet been reported. There is evidence that various strains of viral encephalides are periodically found in native and migratory wildlife populations which apparently serve as reservoirs for viral inoculum. Abundant mosquito populations could enhance the rate of disease transmission should local disease outbreaks occur. Mr. Davis pointed out, however, that no cases of malaria have been recorded from Texas residents over the past 20 years.

d. Amphibians and reptiles. The Sulphur River has a typical array of amphibians and reptiles. None of the amphibians presently occurring in the area is considered threatened or endangered. Among the reptiles, only the American alligator is listed as an endangered species whose range has extended into the basin (US Department of Interior, 1974). The American alligator is known to inhabit the Sulphur River Basin. In addition to the remnant native population, the Arkansas Game and Fish Commission released approximately 150 alligators at the Sulphur River Wildlife Management Area in Miller County, Arkansas, during 1971, 1972, and 1973, as a part of the Arkansas Game and Fish Commission endangered species management program (provided by comment from US Department of Interior, letter dated 17 August 1976).

(1) The amphibians and reptiles of the Sulphur River Basin were inventoried by Dr. Arthur M. Pullen and Dr. Donald A. Ingold, Department of Biology, East Texas State University (East Texas State University, 1971). Field observations and collections from Texas A&M University, Southern Methodist University, University of Texas at Arlington, East Texas State University, Fair Park Museum of Natural History (Dallas, Texas), and the Fort Worth Museum of Science and Natural History were utilized to complete the list. The records of Brown (1950), Greding (1962), and Conant (1948) aided in identification and in determining the distribution of species.

(2) Frogs and salamanders inhabit the margins of the aquatic habitats. Several species such as the three-toed amphiuma and Western lesser siren are almost exclusively aquatic. Among the reptilian fauna of the area, turtles are generally considered to be the more aquatic, although two species, the common box turtle and the ornate box turtle, are terrestrial. Some of the snakes, such as the western cottonmouth, mud snake, diamond-backed water snake, and yellow-bellied water snake are primarily aquatic. Other snakes are found in dry to semiaquatic conditions of many habitats; these include the copperhead, canebrake rattlesnake, rat snake, common kingsnake, eastern coral snake, rough green snake, brown snake, flat-headed snake, ribbon snake, common garter snake, and worm snake. The Eastern yellow-bellied racer, ringneck snake, rough earth snake, western earth snake, western hognose snake, eastern hognose snake, prairie kingsnake, coachwhip, and lined snake also inhabit a variety of terrestrial habitats. The lizards of the area occupy similar habitats. At times such species as the green anole, five-line skink, broad-headed skink, Texas spiny lizard and fence lizard are arboreal. Others normally inhabit the debris and litter of woodlands or the open grassland prairies. These include the

coal skink, ground skink, Texas horned lizard, eastern spotted whiptail, six-lined racerunner, and prairie skink.

e. Fishes. The results of three fish surveys in the Sulphur River drainage area are summarized in table II-8. The most extensive survey was conducted by E. W. Bonn and C. R. Inman (1955) from 1 July 1954 to 30 June 1955. The survey involved 396 collections made at 212 locations in lakes, sloughs, bayous, creeks, and rivers in the Sulphur River drainage of northeast Texas. Collections were taken with seines, gill nets, hoop nets, and rotenone. The collection of Clark Hubbs and Kirk Strawn (1953) was made in July 1953. Hubbs and Strawn seined side pools of the South Sulphur River south of Douglassville and at the present site of the Wright Patman Dam about 10 miles southwest of Texarkana. The 1971 survey was made by Dr. Donald A. Ingold, Associate Professor of Biology, East Texas State University, Commerce, Texas, in June and July. All collections were taken with seines, and collection sites (plate II-5) were restricted to the main channels of the North, Middle, and South Sulphur Rivers and Cuthand Creek. Collection sites were evenly distributed along the river channels from their starting places in Hunt and Fannin Counties to the mouth of the Sulphur River in the southwestern corner of Arkansas.

(1) Because of variation in collection techniques and seasonal and annual variation in habitats where collections were made, abundance data were interpreted only as occurrence in a given sample. The gill net samples and rotenone collections by Bonn and Inman give the best comparison of relative abundance of the species collected (tables II-9 and II-10). The larger number of species in the Bonn-Inman Collection compared to the other two collections is due to: (1) year-round collections by Bonn and Inman, (2) the use of four collection methods including rotenone, and (3) collecting extensively from lakes, sloughs, and bayous in the drainage area.

(2) A comparison of fish collected from unchannelized with those collected from portions of the South Sulphur River channelized in 1959 (table II-11) reveals several basic similarities. Twenty species were collected from the unchannelized waterway and 18 from channelized portions of the river. Fourteen species were common to both unchannelized and channelized portions of the river. Among these, seven (gizzard shad, redfin shiners, red shiners, ghost shiners, fathead minnows, top minnows, and green sunfish) were frequent to very abundant in both. In addition to those seined from both types of channels, black bullheads were taken on hook and line from both areas. It appears, therefore, that the basic composition (species and numerical) of fish populations from channelized and unchannelized portions of the South

Table II-8

Fish Occurring in the Sulphur River Basin

Scientific Name	Common Name	Collections		
		E. W. Bonn	Clark Hubbs	D. A. Ingold
Alosa chrysochloris	Skipjack herring	X	X	
Amia calva	Bowfin	X	X	
Ammocrypta vivax	Scaly sand darter		X	
Anguilla rostrata	American eel		X	
Aphredoderus sayanus	Pirate perch	X	X	
Aplodinotus grunniens	Freshwater drum	X	X	X
Campostoma anomalum	Stoneroller	X		X
Carpiodes carpio	River carpsucker	X	X	X
Centrarchus macropterus	Flier	X	X	
Cyprinus carpio	Carp	X		X
Dorosoma cepedianum	Gizzard shad	X	X	X
Dorosoma petenense	Threadfin shad	X		
Elassoma zonatum	Banded pigmy sunfish	X	X	
Erimyzon oblongus	Creek chubsucker	X		
Erimyzon sucetta	Lake chubsucker	X		
Esox americanus	Grass pickerel	X	X	
Etheostoma artesiae	Eastern redfin darter	X	X	
Etheostoma a[illegible]rigene	Mud darter	X		
Etheostoma c[illegible]osomum	Bluntnose darter	X	X	
Etheostoma fus[illegible]rme	Swamp darter	X		
Etheostoma grac[illegible]	Slough darter	X	X	
Etheostoma par[illegible]ne	Goldstripe darter	X		

X = Occurrence

Table II-8 (Cont'd)

Scientific Name	Common Name	Collections: E. W. Bonn	Clark Hubbs	D. A. Ingold
Etheostoma proeliare	Cypress darter	X		
Etheostoma spectabile	Orangethroat darter	X	X	
Etheostoma whipplei	Redfin darter	X		
Fundulus notatus	Blackstripe topminnow	X	X	X
Gambusia affinis	Mosquitofish	X	X	X
Hybognathus nuchalis	Silvery minnow	X	X	X
Hybopsis aestivalis	Speckled chub	X		
Hybopsis storeriana	Silver chub	X		
Ichthyomyzon castaneus	Chestnut lamprey	X		
Ictalurus furcatus	Blue catfish	X		
Ictalurus melas	Black bullhead	X	X	X
Ictalurus natalis	Yellow bullhead	X		
Ictalurus punctatus	Channel catfish	X	X	X
Ictiobus bubalus	Smallmouth buffalo	X	X	
Ictiobus cyprinellus	Bigmouth buffalo	X		
Ictiobus niger	Black buffalo	X		
Labidesthes sicculus	Brook silverside	X	X	X
Lepisosteus oculatus	Spotted gar	X		
Lepisosteus osseus	Longnose gar	X		
Lepisosteus platostomus	Shortnose gar	X	X	
Lepisosteus spatula	Alligator gar	X		
Lepomis auritus	Redbreast sunfish	X		
Lepomis cyanellus	Green sunfish	X	X	X
Lepomis gulosus	Warmouth	X	X	X
Lepomis humilis	Orangespotted sunfish	X	X	X
Lepomis macrochirus	Bluegill	X	X	X

Table II-8 (Cont'd)

Scientific Name	Common Name	Collections: E. W. Bonn	Collections: Clark Hubbs	Collections: D. A. Ingold
Lepomis marginatus	Dollar sunfish			X
Lepomis megalotis	Longear sunfish	X	X	X
Lepomis microlophus	Redear sunfish	X	X	X
Lepomis punctatus	Spotted sunfish	X		
Lepomis symmetricus	Bantam sunfish			X
Micropterus punctulatus	Spotted bass	X	X	
Micropterus salmoides	Largemouth bass	X	X	X
Minytrema melanops	Spotted sucker	X	X	
Morone chrysops	White bass	X	X	
Notemigonus crysoleucas	Golden shiner	X	X	X
Notropis amnis	Pallid shiner	X	X	
Notropis atherinoides	Emerald shiner	X		
Notropis atrocaudalis	Blackspot shiner	X		
Notropis buchanani	Ghost shiner	X	X	X
Notropis cornutus	Common shiner	X		
Notropis emiliae	Pugnose minnow	X	X	
Notropis fumeus	Ribbon shiner	X		
Notropis lutrensis	Red shiner	X		X
Notropis maculatus	Taillight shiner	X		
Notropis potteri	Chub shiner	X		
Notropis texanus	Weed shiner	X		
Notropis umbratilis	Redfin shiner	X		X
Notropis venustus	Blacktail shiner	X		
Noturus gyrinus	Tadpole madtom	X	X	X
Noturus nocturnus	Freckled madtom	X	X	
Percina caprodes	Logperch	X		
Percina maculata	Blackside darter	X	X	
Percina shumardi	River darter		X	

Table II-8 (Cont'd)

Scientific Name	Common Name	Collections		
		E. W. Bonn	Clark Hubbs	D. A. Ingold
Phenacobius mirabilis	Suckermouth minnow	X		
Pimephales promelas	Fathead minnow	X		X
Pimephales vigilax	Bullhead minnow	X	X	X
Pomoxis annularis	White crappie	X	X	X
Pomoxis nigromaculatus	Black crappie	X	X	
Pylodictis olivaris	Flathead catfish	X	X	
Semotilus atromaculatus	Creek chub	X		

Source: East Texas State University, 1971.

Table II-9

Results of Periodic, Random Gill Net Collections in Sulphur River Drainage*

Species	Number	Percent of Total Number	Weight (lbs)	Percent of Total Weight
Alligator gar	1	0.07	15.0	1.24
Shortnose gar	55	3.99	93.9	7.75
Spotted gar	29	2.11	55.0	4.54
Longnose gar	73	5.30	233.0	19.24
Bowfin	4	0.29	14.3	1.18
Gizzard shad	206	14.96	119.6	9.87
Grass pickerel	1	0.07	0.6	0.05
Bigmouth buffalo	15	1.09	40.1	3.31
Black buffalo	6	0.44	12.3	1.09
Smallmouth buffalo	83	6.03	82.6	6.82
River carpsucker	79	5.74	75.4	6.23
Spotted sucker	17	1.23	29.1	2.40
Lake chubsucker	11	0.80	5.4	0.45
Carp	11	0.80	17.4	1.44
Golden shiner	9	0.65	1.6	0.13
Channel catfish	31	2.25	36.8	3.04
Blue catfish	2	0.15	1.4	0.12
Black bullhead	57	4.14	31.8	2.63
Yellow bullhead	19	1.38	14.1	1.16
Flathead catfish	4	0.29	6.6	0.54
White bass	13	0.94	13.7	1.13
Largemouth black bass	49	3.56	104.4	8.62
Spotted black bass	2	0.15	1.3	0.11
Warmouth	12	0.87	5.3	0.44
Redear sunfish	52	3.78	14.6	1.27
Bluegill	239	17.36	52.6	4.34
White crappie	248	18.01	88.8	7.33
Black crappie	23	1.67	15.0	1.24
Drum	26	1.89	29.4	2.43
Total	1,377	100.01	1,211.2	100.14

*Taken from Job Completion Report by E. W. Bonn and C. R. Inman, Project No. F8R2, Jobs A-2 - B-10, July 1, 1954 - June 30, 1955.

Table II-10

Results of Periodic, Random Rotenone Collections in Sulphur River Drainage*

Species	Number	Percent of Total Number	Weight (lbs)	Percent of Total Weight
Longnose gar	43	6.8	69.1	8.0
Spotted gar	16	2.5	15.4	1.8
Bowfin	3	0.5	8.1	0.9
Gizzard shad	6	1.0	0.6	0.1
River carpsucker	4	0.6	3.8	0.4
Smallmouth buffalo	315	50.1	373.6	43.3
Bigmouth buffalo	15	2.4	45.3	5.2
Black buffalo	15	2.4	37.8	4.4
Carp	54	8.6	152.9	17.7
Flathead catfish	7	1.1	13.6	1.6
Channel catfish	58	9.2	85.1	9.9
Largemouth black bass	7	1.1	4.7	0.5
Spotted black bass	1	0.2	00.4	0.1
Bluegill	21	3.3	1.7	0.2
White crappie	21	3.3	5.4	0.6
Drum	43	6.8	45.5	5.3
Totals	629	99.9	863.0	100.0

Miscellaneous species identified but not counted or weighed include: golden shiner, emerald shiner, blacktail shiner, red shiner, pallid shiner, ghost shiner, silvery minnow, parrot minnow, tadpole madtom, freckled madtom, black bullhead, gambusia, pirate perch, longear sunfish, warmouth, green sunfish, orangespotted sunfish, black crappie, blackstripe topminnow, western swamp darter, bluntnose darter, and blacksides darter.

*Taken from Job Completion Report by E. W. Bonn and C. R. Inman, Project No. F8R2, Jobs A-2 - B-10, July 1, 1954 - June 30, 1955.

Table II-11

COMPARISON OF SPECIES OF CHANNELIZED AND UNCHANNELIZED STREAMS

A - abundant (50% or more of sample), C - common (5-49% of sample), UC - uncommon (1-4% of sample)

Note: These designations refer only to numerical proportions based on seining samples and should not be interpreted in an absolute sense.

Scientific Name	Common Name	Cuthand Creek (Channel)	North Sulphur (Channel)	South Sulphur (Channel)	South Sulphur (Unchannel)
Aplodinotus grunniens	Freshwater drum	C			
Campostoma anomalum	Stoneroller		C		
Carpiodes carpio	River carpsucker	C	C	C	UC
Cyprinus carpio	Carp	UC		UC	
Dorosoma cepedianum	Gizzard shad	C		C	C
Fundulus notatus	Blackstripe topminnow			UC	UC
Gambusia affinis	Mosquitofish	C		C	C
Hybognathus nuchalis	Silvery minnow	C	C		
Ictalurus melas	Black bullhead			*	*
Ictalurus punctatus	Channel catfish		C	UC	UC
Ictiobus cyprinellus	Bigmouth buffalo				UC
Labidesthes sicculus	Brook silverside				C
Lepisosteus oculatus	Spotted gar			UC	C
Lepomis cyanellus	Green sunfish	C	C	C	C
Lepomis humilis	Orangespotted sunfish		UC	UC	C
Lepomis macrochirus	Bluegill	C	UC	C	

* Frequently caught on hook and line in both channel types.

Table II-11 (Cont'd)

Scientific Name	Common Name	Cuthand Creek (Channel)	North Sulphur (Channel)	South Sulphur (Channel)	South Sulphur (Unchannel)
Lepomis marginatus	Dollar sunfish				UC
Lepomis megalotis	Longear sunfish				C
Lepomis microlophus	Redear sunfish			UC	
Lepomis symmetricus	Bantam sunfish		UC		C
Micripterus salmoides	Largemouth bass	UC	UC	UC	C
Notropis buchanani	Ghost shiner			C	C
Notropis lutrensis	Red shiner	C	A	C	A
Notropis umbratilis	Redfin shiner			C	C
Noturus gyrinus	Tadpole madtom			UC	
Pimephales promelas	Fathead minnow	C	C	C	C
Pimephales vigilax	Bullhead minnow		C		C
Pomoxis annularis	White crappie	C		UC	C
	TOTAL NUMBER OF SPECIES	12	13	18	20

Source: East Texas State University, 1971.

Sulphur River are very similar. This conclusion is apparently related to the fact that most channelized portions of the river have gradually recovered in the sense that they now provide essentially the same types of aquatic habitats as do unchannelized portions of the channel. There are now deep holes, shady pools, and shallow riffles in the channelized portion of the river similar to those in the unchanneled portion. This recovery, however, has not appreciably reduced the efficiency of flood water drainage through channeled portions.

(3) Sixteen species were collected from the Middle Sulphur River which has been partially channelized. All but two (golden shiner and warmouth) of these species were also collected from the South Sulphur River. The slightly smaller number of species collected from the Middle Sulphur River is probably due to less niche diversification in this short, intermittent stream than in the relatively extensive and varied South Sulphur River.

(4) A portion of the North Sulphur River has been channelized. This channel, at present, is a broad, open ditch with shallow, warm pools in the summer. Reappearance of deep holes, shady pools, and shallow riffles is apparent only on the extreme lower reaches of the stream. At the present time there is little niche diversity in the North Sulphur River which, in turn, is reflected in relatively little species diversity among fish populations in this river. Extensive collections yielded only 13 species of fish from the North Sulphur River. Three of these species (silvery minnow, bluntnose minnow, stoneroller) were not collected from either the South Sulphur or Middle Sulphur Rivers. This suggests that there are not only fewer niches in the North Sulphur than in the Middle and South Sulphur Rivers, but that some of these niches occur in neither of the latter streams. It is probable that these niche differences in the North Sulphur are associated with shallow water and relatively high water temperatures.

(5) Cuthand Creek, which has also been channelized, yielded about the same number of species (12) as the North Sulphur River. Only one of these species (freshwater drum) was not collected from the North, Middle, or South Sulphur Rivers.

(6) Despite habitat differences associated with the two channel types, there were ten species of fish (gizzard shad, river carpsucker, red shiner, fathead minnow, gambusia, largemouth bass, green sunfish, bluegill, orangespotted sunfish, and white crappie) that were widely distributed throughout most of the streams

from which collections were made. This group of fish, which is tolerant of conditions associated with both channeled and unchannelized streams, includes both forage and popular game species. The results of the surveys in the basin did not reveal any species of fish which are considered to be threatened or endangered (US Department of Interior, 1974; Miller, 1972).

f. Birds. The most numerous species in the game bird group are the migratory waterfowl. The most common bird in this group is the wood duck, which not only winters in the basin but also nests there. Other waterfowl which winter in the area include the northern pintail, green-winged teal, cinnamon teal, blue-winged teal, mallard, black duck, gadwall, shoveler, white-fronted goose, lesser scaup, redhead, ring-necked duck, greater scaup, canvasback, Canada goose, bufflehead, common goldeneye, blue goose, snow goose, hooded merganser, American widgeon, oldsquaw, common merganser, red-breasted merganser, and ruddy duck. Other water birds also inhabiting open waters are the American coot, common loon, double-crested cormorant, anhinga, white pelican, eared grebe, and pied-billed grebe; of the latter, the American coot is a huntable species. Birds that normally inhabit wetland areas especially for feeding include the sandpipers, herons, ruddy turnstones, plovers, bitterns, egrets, common snipe, willets, killdeer, terns, marsh wrens, fish crows, rails, dunlins, sanderlings, ibises, gallinules, sandhill cranes, gulls, dowitchers, Hudsonian godwits, belted kingfishers, long-billed curlews, ospreys, American woodcock, American avocets, waterthrushes, Wilson's phalaropes, and yellowlegs. Upland game bird species of the basin are the bobwhite, wild turkey, and mourning dove. The list of upland nongame birds is rather lengthy and contains such bird groups as the sparrows, hummingbirds, finches, grackles, swifts, swallows, cuckoos, flickers, woodpeckers, warblers, flycatchers, blackbirds, thrushes, orioles, juncos, mockingbirds, cowbirds, buntings, grosbeaks, tanagers, purple martins, kinglets, longspurs, bluebirds, nuthatches, meadowlarks, wrens, kingbirds, and vireos. Birds of prey include the hawks, owls, falcons, kites, shrikes, osprey, and the southern bald eagle.

(1) The southern bald eagle, whooping crane, and peregrine falcon are on the US Department of Interior (1974) Endangered Fauna List. The range of the red-cockaded woodpecker extends into the basin, although it was not listed in the inventory by East Texas State University (1971). These species are also listed as endangered in the Texas Parks and Wildlife Department "Regulations for taking, possessing, transporting, exporting, processing, selling, or offering for sale, or shipping endangered species" as amended in May 1976.

(2) The checklist of birds of the Sulphur River Basin was compiled by Dr. Arthur M. Pullen, Department of Biology, East Texas State University (East Texas State University, 1971). In addition to the personal field observations, the museum collections housed at East Texas State University, Texas A&M University, University of Texas at Arlington, Fort Worth Museum of Science and Natural History, and Fair Park Museum of Natural History (Dallas) were utilized in compiling the list.

g. Mammals. The survey of mammals of the Sulphur River Basin was conducted by Dr. Arthur M. Pullen, Department of Biology, East Texas University. This, plus the following additional sources, were utilized to compile a checklist: East Texas State University, Southern Methodist University, University of Texas at Arlington, Fair Park Museum of Natural History, and Fort Worth Museum of Science and Natural History.

(1) None of the 42 species of mammals, listed by East Texas State University (1971) as occurring in the basin, are on the lists of threatened or endangered species. The red wolf (Canis rufus) whose former range included some of the counties in the basin is on the list of endangered species of mammals (US Department of Interior, 1974). Present populations of the red wolf are known to occur in Chambers, Jefferson, and possibly adjacent counties in southeast Texas. The Fish and Wildlife Service (1974) has established a "buffer zone" across the Jasper, Newton, and Tyler County area where they are carrying out extensive trapping of coyotes to reduce coyote infiltration into the red wolf area south of this line.

(2) The white-tailed deer, gray squirrel, fox squirrel, swamp rabbit, and eastern cottontail are the only game mammals in the area. The beaver, opossum, river otter, mink, nutria, muskrat, and raccoon are furbearers of the area; but only the mink, raccoon, and opossum are in adequate abundance for commercial trapping (Alexander, 1973, unpublished data). The records of Davis (1966) and Lowery (1943 and 1974) were utilized in the identification, classification, and distribution of species.

h. Wildlife population statistics

(1) Table II-12 presents wildlife population statistics for the Sulphur River Basin provided by Bobby Alexander (Biologist), Texas Parks and Wildlife Department, Mount Pleasant, Texas, (unpublished data). Two estimates were calculated for the basin; one for the area east of US Highway 271 and one for the area

Table II-12

WILDLIFE POPULATION DATA - SULPHUR RIVER BASIN

Species	Population Density[1]				Percent Kill				Man-Days/Kill			
	Actual		Potential		Actual		Potential		Actual		Potential	
	West of Hw. 271	East of Hw. 271	West of Hw. 271	East of Hw. 271	West of Hw. 271	East of Hw. 271	West of Hw. 271	East of Hw. 271	West of Hw. 271	East of Hw. 271	West of Hw. 271	East of Hw. 271
Deer	1:30.0	1:20.0	1:15.0	1:10.0	10	10	15	20	20	10	7	5
Squirrel	1:2.5	1:1.5	1:2.5	1:1.5	20	20	50	50	.25	.15	.25	.15
Bobwhite	1:50.0	1:75.0	1:10.0	1:10.0	30	20	50	50	.50	.50	.20	.20
Mourning Dove	1:7.0	1:100.0	1:2.0	1:5.0	40	20	40	40	.25	.50	.25	.25
Rabbits	1:5.0	1:10.0	1:3.0	1:3.0	5	2	50	50	.50	.75	.30	.30
Woodcock	1:40.0	1:40.0	1:40.0	1:40.0	.05	.05	10	10	1	1	.50	.50
Turkey	None present and no potential			1:250.0	No estimate			20	No estimate			.25
Waterfowl	No estimate made				No estimate made				.50	.50	.25	.25
Raccoon	1:10.0	1:10.0	1:10.0	1:10.0	5	5	40	40	.30	.30	.30	.30
Opossum	1:20.0	1:20.0	1:20.0	1:20.0	5	5	35	35	.20	.20	.20	.20
Mink (trapping)	1:100.0	1:100.0	1:100.0	1:100.0	10	10	50	50	3	3	3	3
Raccoon (trapping)	1:10.0	1:10.0	1:10.0	1:10.0	2	2	50	50	.50	.50	.25	.25
Opossum (trapping)	1:20.0	1:20.0	1:20.0	1:20.0	2	2	35	35	1	1	.50	.50

Source: Bobby Alexander (Biologist), Texas Parks and Wildlife Department, 1974.
[1]Number of individuals per acres of habitat.

west of US Highway 271. These data indicate that higher population densities of deer and squirrels occur in the eastern sector of the basin, whereas higher population densities of bobwhite, mourning doves, and rabbits occur west of Highway 271. Examination of kill percentages, however, indicates in almost every instance that game species are not being harvested at maximum sustainable yield levels.

(2) Although a majority of the northeast Texas project counties support a surplus population of deer adequate to allow a season, no surplus turkey populations were found in the northeast Texas Area (Alexander, 1972 - Job No. 3).

(3) Walter A. Gresh (letter report from Regional Director, Bureau of Sport Fisheries and Wildlife, dated 13 July 1966; letter reproduced in its entirety in appendix F, which is now on file at the New Orleans District office) indicates that "the existing fishery above the proposed Cooper Dam site is of little significance, ...during the summer months, only the deeper holes retain suitable water for fish." Below the dam site, fishing opportunity increases progressively with stream size. Wildlife habitat above the dam site is of low to moderate value, with hunting potential limited entirely to small game. Quail, squirrels, rabbits, raccoons, and mourning doves are hunted and provide the best hunting opportunities. "There is a small annual harvest of mink by hunting with dogs, but little or no trapping for other fur bearers." Below the dam site, the flood plain has moderate to high wildlife value, providing attractive hunting for squirrel, deer, waterfowl, and other game (table II-13).

2.06 RECREATIONAL ELEMENTS

a. General. Recreational use of the Sulphur River basin, historically, has been limited in activities such as fishing, hunting, swimming, boating, camping, hiking, sightseeing, pleasure driving, horseback riding, nature study, and picnicking. Limited participation in the above activities primarily resulted from the lack of development of natural resources necessary to stimulate more intensive recreational use (East Texas State University, 1971). Recently, however, the construction of reservoirs in the region has provided more recreational opportunities and broadened the recreational interests of the local population and has attracted nonresident recreational visitors to the area.

b. Natural recreation conditions. Within the Sulphur River basin, natural areas and water bodies do not possess characteristics which attract large numbers of recreationists or encourage

Table II-13

Summary of Annual Fish and Wildlife Utilization of the Project Area

Without Project		With Project	
Resource	Man-Days	Initial[1] Man-Days	Ultimate[2] Man-Days
Sport Fishing			
Reservoir	-	105,000	174,000
Tail water	-	10,000	10,000
Stream	13,000	2,000	2,000
Commercial Fishing			
Reservoir (food fish)	-	84,000 (lbs.)	139,000 (lbs.)
Reservoir (nonfood fish)	-	168,000 (lbs.)	278,000 (lbs.)
Stream	50,000 (lbs.)	7,000 (lbs.)	7,000 (lbs.)
Wildlife			
Reservoir area	4,700	2,600 (waterfowl only)	4,300 (waterfowl only)
Downstream area	40,000	32,800	32,800

[1] 1970-1980
[2] 1980-2070

Source: Taken from a 13 July 1966 letter by Walter A. Gresh, Regional Director, Bureau of Sport Fisheries and Wildlife to the District Engineer, New Orleans District, US Army Corps of Engineers.

recreation facility development. The undeveloped topographic and geologic features in the region do not constitute major recreational attractions. There are a number of mineral springs in the basin area which purportedly have curative properties; however, these mineral springs have been known for many years without generating significant use. The flora and fauna of the area, while fairly abundant and diverse, are not sufficiently unique to be classed as major attractions. Use of the Sulphur River for water oriented recreation has, in the past, been limited because of the seasonal and undependable flow of the river, lack of adequate access, and because water in this form is not highly preferred by recreationists (East Texas University, 1971). The Texas Outdoor Recreation Plan (TORP) indicates the presence of two rural natural resources in the Cooper Lake project area; it cites the Executive Committee of the Texas Natural Areas Survey as its source authority. These areas are:

(1) <u>Horton Bottom</u>. This is a 5-square-mile area located on the north branch of the South Sulphur River and is reported as a zone 1 mile wide from Highway 1531 to the confluence of Merritt Creek. Reportedly found within this area are numerous archaeological sites and an oak-hickory forest. This area is included in the right-of-way acquired for Cooper Lake. However, with the exception of a few hundred yards on either side of the South Sulphur River, all of Horton Bottom has been cleared and is under cultivation and/or in pastureland. The forested area adjacent to the inundated segments of the river will not be disturbed by the project. According to Dr. S. Alan Skinner, Director of the Archeology Research Program at Southern Methodist University, Dallas, Texas, one substantive archeological site is located in this area; but, in general, the area is devoid of sites (telephone communication in September 1976).

(2) <u>Sulphur River</u>. The Sulphur River Basin extends through Bowie, Delta, Red River, and Titus Counties. A half-mile to 1-mile riverfront zone is reported to contain southern flood plain forest with great quantities of wildlife and numerous lakes and sloughs. The relatively undeveloped, natural state of the Sulphur River Basin is considered in this document.

c. <u>Existing development</u>. Only limited recreational development has occurred in the basin except in areas stimulated by the construction of reservoirs. The most significant recreation development in the basin is provided at Wright Patman Lake. At this lake, Atlanta State Park, approximately 24 US Army Corps of Engineers recreation areas, and six privately operated concessions

provide for many types of activities including camping, picnicking, boating, waterskiing, hunting, swimming, and fishing. The Bonham State Park, which is also located in the Sulphur River basin near Bonham, offers facilities for trailer camping, group camping, picnicking, fishing, swimming, and miniature golf. The Governor James S. Hogg Memorial, a state park not in the basin, but within a 50-mile radius of the Cooper Lake site, is developed for day use only with picnicking and sanitary facilities. The primary attraction is the historic structure and exhibit commemorating the late Governor Hogg. Within a 51-100 mile radius there are four state parks, including Atlanta State Park. Daingerfield State Park, near Daingerfield, is developed for picnicking, fishing, boating, waterskiing, nature study, and camping. Tyler State Park, located 8 miles north of Tyler, is highly developed and is a major outdoor recreational attraction in the region. Eisenhower State Park, located on Lake Texoma near Denison is developed for camping, picnicking, and boating. Table II-14 shows the visitation for the two state parks located in the Sulphur River Basin.

Table II-14

State Parks Visitation

Bonham State Park

	1970	1971	1972*	1973
Cars	46,820	39,590	23,280	21,760
Campers	3,300	3,190	4,640	2,510
Day Use	105,440	97,593	80,070	71,248
Total Users	108,740	100,783	84,710	73,758

Atlanta State Park

	1970	1971	1972*	1973
Cars	23,220	24,060	22,780*	23,976
Campers	4,550	6,820	5,240	5,110
Day Use	61,414	62,246	57,119	62,153
Total Users	65,964	69,066	62,359	67,263

Source: Texas Parks and Wildlife Department, Austin, Texas, 1974.
*Change in recording method for computing park visitors.

The region within the 50-mile radius of the Cooper Lake site contains a number of small lakes and several large reservoirs which are developed, to some extent, for recreational use. These lakes total 65,881 surface acres. Within the 51-100 mile radius of Cooper Lake there are 27 lakes and reservoirs totaling 373,197 surface acres. Table II-15 lists the lakes within a 100-mile radius of Cooper Lake.

d. Regional recreation demand. Estimates from the Texas Outdoor Recreation Plan furnished by the Texas Parks and Wildlife Department indicate an existing and future need for opportunities for many types of outdoor recreation in the Sulphur River Basin. The Sulphur River Basin is contained within 11 Texas counties and one Arkansas county. Nine of the 11 Texas counties are included in Texas Comprehensive Planning Region 13; these include Cass, Bowie, Delta, Hopkins, Lamar, Franklin, Morris, Titus, and Red River Counties. Hunt and Fannin Counties are part of Texas Comprehensive Planning Region 12. Under the Texas Outdoor Recreation Plan (TORP), there are 36 Comprehensive Planning Regions. These regions basically partition the same counties as do the 24 Governor's Planning Regions currently in use for planning by the Texas Council of Governments, with the exception that large metropolitan areas have been broken out and given individual planning status. In all cases the newly defined TORP metro-regions can be combined with the appropriate adjacent rural regions to yield the original 24 Governor's Planning Regions. The new Texas TORP Comprehensive Planning Regions thus incorporate smaller numbers of counties and allow for a more detailed analysis of recreational demand and supply on a regional as well as a state-wide basis. Data from the Texas Outdoor Recreation Plan include demand, supply, and needs data for Comprehensive Planning Regions 12 and 13. These data include information taken from the rural volumes of the Texas Outdoor Recreation Plan for the years 1975, 1980, and 1990. Needs for resources and facilities exist for many activities for 1975 through 1990. The demand, supply in activity days available, and the recreation resource requirements (needs) are shown for 12 selected outdoor recreation activities in tables II-16 through II-21. As indicated, rural lakes and reservoirs currently existing in Regions 12 and 13 are projected to adequately satisfy requirements for boating, boat fishing, and skiing in rural areas through the year 2000. This potential, however, is not being realized because of a lack of adequate access facilities. In contrast, adequate access facilities are proposed at Cooper Lake.

Table II-15

Competing Recreation Lakes
(Within 100-mile Radius of Cooper Lake Site)

	Name	Distance Zone (Airline Miles)	Size (Acres)	Or Length (Miles)	County or Parish	Public Access and Facilities	Annual Attendance (1970)
1.	Blundell Reservoir, Texas	0-50	2,000		Titus	yes	Not Available (NA)
2.	Lake Tawakoni, Texas	"	36,700		Hunt	yes	NA
3.	Lake Crook, Texas	"	1,226		Lamar	yes*	NA
4.	Pat Mayse Reservoir, Texas	"	5,993		Lamar	yes	634,900
5.	Cypress Springs Reservoir, Texas	"	3,450		Franklin	yes	NA
6.	Lake Winnsboro, Texas	"	1,268		Wood	yes*	NA
7.	Lake Hawkins, Texas	"	1,064		Wood	yes*	NA
8.	Lake Holbrook, Texas	"	650		Wood	yes*	NA
9.	Lake Quitman, Texas	"	2,450		Wood	yes*	NA
10.	Lavon Reservoir, Texas	"	11,080		Collin	yes	3,027,800
		Subtotal	65,881				
11.	Red River, Texas, and Oklahoma			120			
1.	Moss Lake, Texas	51-100	1,125		Cooke	yes	NA
2.	Lake Texoma, Texas, and Oklahoma	"	89,000		Grayton (Tex) Marshall (Okla)	yes	9,715,500
3.	Garza-Little Elm, Texas	"	22,970		Denton	yes	2,137,400
4.	Grapevine Reservoir, Texas	"	7,380		Denton-Tarrant	yes	2,539,500
5.	Lake of the Pines, Texas	"	20,032		Marion	yes	4,351,760
6.	Wright Patman Lake and Dam	"	34,925		Cass and Bowie	yes	2,434,297
7.	Lake Ray Hubbard, Texas	"	22,745		Dallas	yes	NA
8.	Bardwell Lake, Texas	"	3,570		Ellis	yes	698,300
9.	Cedar Creek Reservoir, Texas	"	34,000		Henderson	yes	NA

(Continued on next page)

Table II-15 (Cont'd)

	Name	Distance Zone (Airline Miles)	Size (Acres)	Or Length (Miles)	County or Parish	Public Access and Facilities	Annual Attendance (1970)
10.	Palestine Lake, Texas	51-100	25,500		Henderson	yes	NA
11.	Lake Athens, Texas	"	1,500		Henderson	yes*	NA
12.	Lake Trinidad, Texas	"	700		Henderson	yes*	NA
13.	Lake Waxahachie, Texas	"	645		Ellis	yes*	NA
14.	Lake Jacksonville, Texas	"	1,350		Cherokee	yes*	NA
15.	Mountain Creek, Texas	"	2,940		Dallas	yes	NA
16.	North Lake, Texas	"	820		Dallas	yes	NA
17.	White Rock, Texas	"	1,095		Dallas	yes	NA
18.	Lake Tyler East and West, Texas	"	4,950		Smith	yes	NA
19.	Striker Lake, Texas	"	2,000		Rush	yes*	NA
20.	Lake Arlington, Texas	"	2,000		Tarrant	yes	NA
21.	Caddo Lake, Texas, and Louisiana	"	27,200		Marion (Tex)	yes	NA
					Caddo (La)		NA
22.	Broken Bow Reservoir, Oklahoma	"	14,200		McCurtain	yes	879,600
23.	Pine Creek Reservoir, Oklahoma	"	3,800		McCurtain	yes	276,600
24.	Atoka Lake, Oklahoma	"	2,000		Atoka	yes*	NA
25.	Millwood Reservoir, Arkansas	"	29,500		Little River-	yes	
					Sevier		2,240,100
26.	Lake Cherokee, Texas	"	4,000		Rusk	yes*	NA
27.	Red River, Texas, and Oklahoma	"		110		yes*	NA
		Subtotal	358,822				
		Total	424,703				

Source: Texas Parks and Wildlife Department, Austin, Texas, 1974.
*Boating Access Only

AD-A100 099 ARMY ENGINEER DISTRICT NEW ORLEANS LA F/G 13/2
COOPER LAKE AND CHANNELS, TEXAS.(U)
APR 77

UNCLASSIFIED NL

2 of 5
AD
A100099

Table II-16

Recreation Resource Requirements
1975
Region 12

Activity	Total Participation (Thousand's of Activity Days)	1973 Opportunity Days Available (Thousand's of Activity Days)	Additional Opportunities Required (Thousand's of Activity Days)		Units of Recreation Resources Required	
			Deficit	Surplus	Cumulative	Incremental
Camping	3,332	745	2,587		4,326.09 sites	2,474.92 sites
Child's Play	74	90		16	0 acres	0 acres
Golf	37	426		389	0 holes	0 holes
Baseball/Softball	58	0	58		7.70 fields	4.40 fields
Hunting	514	143	371		265,000.00 acres	157,857.14 acres
Picnicking	4,517	1,040	3,477		3,804.16 tables	2,242.89 tables
Boating, Boat Fishing, Skiing	10,144	53,510		43,366	0 surface acres	0 surface acres
Boat Ramps[1]-Freshwater	6,887	1,889	4,998		208.09 ramps	167.79 ramps
Boat Slips and Stalls-Freshwater	1,456	430	1,026		3,431.44 structures	2,979.93 structures
Fishing Piers, Barges, Marinas	790	1,061		271	0 linear yards	0 linear yards
Swimming Pools[2]	488	14	474		43,385.10 square yards	20,045.00 square yards
Swimming-Desig.[2]-Freshwater	2,079	43	2,036		1,336,747.40 square yards	613,223.00 square yards
Bicycling	1,687	0	1,687		110.20 miles	57.40 miles
Horseback Riding	1,824	151	1,673		154.62 miles	86.78 miles
Walking, Hiking, Nature Study	1,154	0	1,154		85.45 miles	33.54 miles

[1]Assumes 2.0 lanes per ramp.

[2]The specified breakdowns of resource requirements for swimming in pools and swimming in designated areas are considered the most desirable for a particular region. However, in some instances, certain circumstances (such as poor water quality, lack of water, etc.) may render it difficult or infeasible to create the most desirable breakdown. In such cases, it is possible to substitute pool swimming for designated fresh-water swimming and vice-versa. The substitution ratio for converting designated freshwater swimming to pool swimming is .14. This means, for example, that 100 square yards of designated freshwater swimming may be substituted for 14 square yards of pools. Conversely, the substitution ratio for converting pool swimming to designated swimming is 7.30. Thus, 100 square yards of pools is equivalent to 730 square yards of designated swimming.

Source: Texas Outdoor Recreation Plan, Texas Parks and Wildlife Department, Austin, Texas, December, 1975.

Table II-17

Recreation Resource Requirements
1980
Region 12

Activity	Total Participation (Thousand's of Activity Days)	1973 Opportunity Days Available (Thousand's of Activity Days)	Additional Opportunities Required (Thousand's of Activity Days)		Units of Recreation Resources Required	
			Deficit	Surplus	Cumulative	Incremental
Camping	4,707	745	3,962		6,625.42 sites	2,299.33 sites
Child's Play	104	90	14		2.23 acres	2.23 acres
Golf	40	426		386	0 holes	0 holes
Baseball/Softball	76	0	76		10.14 fields	2.44 fields
Hunting	654	143	511		365,000.00 acres	100,000.00 acres
Picnicking	9,283	1,040	8,243		9,018.60 tables	5,214.44 tables
Boating, Boat Fishing, Skiing	15,464	53,510		38,046	0 surface acres	0 surface acres
Boat Ramps[1]-Freshwater	10,420	1,889	8,531		355.19 ramps	147.10 ramps
Boat Slips and Stalls-Freshwater	2,219	430	1,789		5,983.28 structures	2,551.84 structures
Fishing Piers, Barges, Marinas	1,232	1,061	171		1,062.11 linear yards	1,062.11 linear yards
Swimming Pools[2]	1,673	14	1,659		151,848.00 square yards	108,462.90 square yards
Swimming-Desig.[2]-Freshwater	7,129	43	7,086		4,652,353.80 square yards	3,315,606.40 square yards
Bicycling	2,302	0	2,302		150.30 miles	40.10 miles
Horseback Riding	2,542	151	2,391		220.98 miles	66.36 miles
Walking, Hiking, Nature Study	1,475	0	1,475		109.22 miles	23.77 miles

[1]Assumes 2.0 lanes per ramp.

[2]The specified breakdowns of resource requirements for swimming in pools and swimming in designated areas are considered the most desirable for a particular region. However, in some instances, certain circumstances (such as poor water quality, lack of water, etc.) may render it difficult or infeasible to create the most desirable breakdown. In such cases, it is possible to substitute pool swimming for designated freshwater swimming and vice-versa. The substitution ratio for converting designated freshwater swimming to pool swimming is .14. This means, for example, that 100 square yards of designated freshwater swimming may be substituted for 14 square yards of pools. Conversely, the substitution ratio for converting pool swimming to designated swimming is 7.30. Thus, 100 square yards of pools is equivalent to 730 square yards of designated swimming.

Source: Texas Outdoor Recreation Plan, Texas Parks and Wildlife Department, Austin, Texas, December, 1975.

Table II-18

Recreation Resource Requirements
1990
Region 12

Activity	Total Participation (Thousand's of Activity Days)	1973 Opportunity Days Available (Thousand's of Activity Days)	Additional Opportunities Required (Thousand's of Activity Days)		Units of Recreation Resources Required	
			Deficit	Surplus	Cumulative	Incremental
Camping	6,092	745	5,347		8,941.47 sites	2,316.05 sites
Child's Play	175	90	85		13.45 acres	11.31 acres
Golf	46	426		380	0 holes	0 holes
Baseball/Softball	119	0	119		15.88 fields	5.74 fields
Hunting	1,010	143	867		619,285.71 acres	254,285.71 acres
Picnicking	12,953	1,040	11,913		13,033.92 tables	4,015.32 tables
Boating, Boat Fishing, Skiing	23,198	53,510		30,312	0 surface acres	0 surface acres
Boat Ramps[1]-Freshwater	15,303	1,889	13,414		558.49 ramps	203.30 ramps
Boat Slips and Stalls-Freshwater	3,329	430	2,899		9,695.65 structures	3,712.37 structures
Fishing Piers, Barges, Marinas	1,605	1,061	544		3,378.88 linear yards	2,316.77 linear yards
Swimming Pools[2]	3,659	14	3,645		333,626.20 square yards	181,778.20 square yards
Swimming-Desig.[2]-Freshwater	15,596	43	15,553		10,211,410.90 square yards	5,559,057.10 square yards
Bicycling	3,683	0	3,683		240.50 miles	90.20 miles
Horseback Riding	4,319	151	4,168		385.21 miles	164.23 miles
Walking, Hiking, Nature Study	2,275	0	2,275		168.46 miles	59.24 miles

[1]Assumes 2.0 lanes per ramp.

[2]The specified breakdowns of resource requirements for swimming in pools and swimming in designated areas are considered the most desirable for a particular region. However, in some instances, certain circumstances (such as poor water quality, lack of water, etc.) may render it difficult or infeasible to create the most desirable breakdown. In such cases, it is possible to substitute pool swimming for designated freshwater swimming and vice-versa. The substitution ratio for converting designated freshwater swimming to pool swimming is .14. This means, for example, that 100 square yards of designated freshwater swimming may be substituted for 14 square yards of pools. Conversely, the substitution ratio for converting pool swimming to designated swimming is 7.30. Thus, 100 square yards of pools is equivalent to 730 square yards of designated swimming.

Source: Texas Outdoor Recreation Plan, Texas Parks and Wildlife Department, Austin, Texas, December, 1975.

Table II-19

Recreation Resource Requirements
1975
Region 13

Activity	Total Participation (Thousand's of Activity Days)	1973 Opportunity Days Available (Thousand's of Activity Days)	Additional Opportunities Required (Thousand's of Activity Days)		Units of Recreation Resources Required	
			Deficit	Surplus	Cumulative	Incremental
Camping	325	33	292	0	579.37 sites	36.69 sites
Child's Play	34	38	0	4	0 acres	0 acres
Golf	37	25	12		4.30 holes	.70 holes
Baseball/Softball	4	11		7	0 fields	0 fields
Hunting	220	486		266	0 acres	0 acres
Picnicking	764	712	52		60.25 tables	60.25 tables
Boating, Boat Fishing, Skiing	1,203	12,515		11,312	0 surface acres	0 surface acres
Boat Ramps[1]-Freshwater	785	543	242		11.70 ramps	11.70 ramps
Boat Slips and Stalls-Freshwater	173	23	150		552.94 structures	361.25 structures
Fishing Piers, Barges, Marinas	77	64	13		146.15 linear yards	0 linear yards
Swimming Pools[2]	43	10	33		3,500.30 square yards	0 square yards
Swimming-Desig.[2]-Freshwater	184	80	104		84,375.00 square yards	0 square yards
Bicycling	40	0	40		1.20 miles	.30 miles
Horseback Riding	66	0	66		5.00 miles	2.50 miles
Walking, Hiking, Nature Study	175	107	68		7.22 miles	7.22 miles

[1]Assumes 2.0 lanes per ramp.

[2]The specified breakdowns of resource requirements for swimming in pools and swimming in designated areas are considered the most desirable for a particular region. However, in some instances, certain circumstances (such as poor water quality, lack of water, etc.) may render it difficult or infeasible to create the most desirable breakdown. In such cases, it is possible to substitute pool swimming for designated freshwater swimming and vice-versa. The substitution ratio for converting designated freshwater swimming to pool swimming is .14. This means, for example, that 100 square yards of designated freshwater swimming may be substituted for 14 square yards of pools. Conversely, the substitution ratio for converting pool swimming to designated swimming is 7.30. Thus, 100 square yards of pools is equivalent to 730 square yards of designated swimming.

Source: Texas Outdoor Recreation Plan, Texas Parks and Wildlife Department, Austin, Texas, December, 1975.

Table II-20

Recreation Resource Requirements
1980
Region 13

Activity	Total Participation (Thousand's of Activity Days)	1973 Opportunity Days Available (Thousand's of Activity Days)	Additional Opportunities Required (Thousand's of Activity Days)		Units of Recreation Resources Required	
			Deficit	Surplus	Cumulative	Incremental
Camping	526	33	493		978.18 sites	398.81 sites
Child's Play	50	38	12		2.23 acres	2.23 acres
Golf	35	25	10		4.30 holes	0 holes
Baseball/Softball	5	11		6	0 fields	0 fields
Hunting	286	486		200	0 acres	0 acres
Picnicking	1,895	712	1,183		1,370.80 tables	1,310.55 tables
Boating, Boat Fishing, Skiing	1,727	12,515		10,788	0 surface acres	0 surface acres
Boat Ramps[1]-Freshwater	1,111	543	568		27.46 ramps	15.76 ramps
Boat Slips and Stalls-Freshwater	248	23	225		829.41 structures	276.47 structures
Fishing Piers, Barges, Marinas	103	64	39		299.46 linear yards	153.31 linear yards
Swimming Pools[2]	100	10	90		7,875.70 square yards	4,375.40 square yards
Swimming-Desig.[2]-Freshwater	425	80	345		215,625.00 square yards	131,250.00 square yards
Bicycling	52	0	52		2.20 miles	1.00 miles
Horseback Riding	90	0	90		6.80 miles	1.80 miles
Walking, Hiking, Nature Study	227	107	120		12.73 miles	5.51 miles

[1]Assumes 2.0 lanes per ramp.

[2]The specified breakdowns of resource requirements for swimming in pools and swimming in designated areas are considered the most desirable for a particular region. However, in some instances, certain circumstances (such as poor water quality, lack of water, etc.) may render it difficult or infeasible to create the most desirable breakdown. In such cases, it is possible to substitute pool swimming for designated freshwater swimming and vice-versa. The substitution ratio for converting designated freshwater swimming to pool swimming is .14. This means, for example, that 100 square yards of designated freshwater swimming may be substituted for 14 square yards of pools. Conversely, the substitution ratio for converting pool swimming to designated swimming is 7.30. Thus, 100 square yards of pools is equivalent to 730 square yards of designated swimming.

Source: Texas Outdoor Recreation Plan, Texas Parks and Wildlife Department, Austin, Texas, December, 1975.

Table II-21

Recreation Resource Requirements
1990
Region 13

Activity	Total Participation (Thousand's of Activity Days)	1973 Opportunity Days Available (Thousand's of Activity Days)	Additional Opportunities Required (Thousand's of Activity Days)		Units of Recreation Resources Required	
			Deficit	Surplus	Cumulative	Incremental
Camping	704	33	671		1,331.35 sites	353.18 sites
Child's Play	95	38	57		10.60 acres	8.37 acres
Golf	32	25	7		4.30 holes	0 holes
Baseball/Softball	7	11		4	0 fields	0 fields
Hunting	394	486		92	0 acres	0 acres
Picnicking	2,939	712	2,227		2,580.53 tables	1,209.73 tables
Boating, Boat Fishing, Skiing	2,495	12,515		10,020	0 surface acres	0 surface acres
Boat Ramps[1]-Freshwater	1,576	543	1,033		49.94 ramps	22.48 ramps
Boat Slips and Stalls-Freshwater	358	23	335		1,234.91 structures	405.50 structures
Fishing Piers, Barges, Marinas	132	64	68		522.14 linear yards	222.68 linear yards
Swimming Pools[2]	162	10	152		13,301.10 square yards	5,425.40 square yards
Swimming-Desig.[2]-Freshwater	692	80	612		382,500.00 square yards	166,875.00 square yards
Bicycling	75	0	75		3.10	.80 miles
Horseback Riding	149	0	149		11.30 miles	4.50 miles
Walking, Hiking, Nature Study	351	107	244		25.89 miles	13.16 miles

[1]Assumes 2.0 lanes per ramp.

[2]The specified breakdowns of resource requirements for swimming in pools and swimming in designated areas are considered the most desirable for a particular region. However, in some instances, certain circumstances (such as poor water quality, lack of water, etc.) may render it difficult or infeasible to create the most desirable breakdown. In such cases, it is possible to substitute pool swimming for designated freshwater swimming and vice-versa. The substitution ratio for converting designated freshwater swimming to pool swimming is .14. This means, for example, that 100 square yards of designated freshwater swimming may be substituted for 14 square yards of pools. Conversely, the substitution ratio for converting pool swimming to designated swimming is 7.30. Thus, 100 square yards of pools is equivalent to 730 square yards of designated swimming.

Source: Texas Outdoor Recreation Plan, Texas Parks and Wildlife Department, Austin, Texas, December, 1975.

In addition, the TORP states:

> "Proximity to water for many land based activities is important to recreationists. In the development of resource requirements for surface acres, the availability and suitability of adjacent reservoir lands and shorelines, use intensity trends, and park occupancy rates on existing reservoirs were not considered in detail. In depth, consideration of these factors may indicate higher surface acreage requirements in order to provide adequate lands adjacent to reservoirs to support the water and land related facility requirements presented in this section."

2.07 ARCHEOLOGICAL AND HISTORICAL ELEMENTS

a. Archeological

(1) Overview of existing data

(a) Paleo-Indian. Throughout the Sulphur River Basin, archeologists have found evidence of man from the prehistoric stage of the Paleo-Indians through the historic stage of the Caddo Indians. The Paleo-Indians probably migrated to the Americas from Siberia during the last stages of the Pleistocene. Theirs was a nomadic life stalking the now-extinct big game mammals (mammoth, camel, ground sloth, cave bear, and the "giant" bison). Climatic changes and the disappearance of the large Ice Age animals brought changes in the adaptive patterns of Paleo-Indians. Hunting emphasis was placed on the white-tailed deer and the modern bison and plant gathering probably became more specialized. Although Paleo-Indian peoples may have reached northeastern Texas approximately 11,000 years ago, there is little direct evidence for this date. Scottsbluff, Plainview (Webb, 1958), Meserve, and Angostura have been found in the area, but most are isolated or scattered finds. A Clovis fluted point was found on the edge of the high terrace near the mouth of the Kiamichi River in Oklahoma. Because no signs of a camping area were found, this Clovis point probably represents a hunting loss. The base of another Clovis point was found in an unexcavated Archaic site about 1½ miles south of the east end of the Sam Kaufman site. The site is located on a high terrace above Big Pine Creek. Although Plainview, Meserve, and Dalton points are found associated with early Archaic dart points at this site, the Clovis base may be a pickup by the Archaic people. No actual Paleo-Indian "sites" have been reported.

(b) Archaic. The Archaic stage in East Texas emerged around 7000-5000 B.C. and lasted generally until about A.D. 1 and perhaps even later in some areas. Archaic sites are usually small and represent a preagricultural prebow and arrow stage of development. Seasonal movement between base camps seems to have been the norm, although in isolated instances, a sedentary existence may have been achieved. Projectile points, which tipped hand-thrown or atlatl-thrown darts, dominate the tool assemblage on Archaic sites, but a far greater range of general utility implements (compared with Paleo-Indian assemblages) are also found. These tools include ovate and triangular bifaces, side and end scrapers, gravers, gouges, drills, spoke shaves, and, significantly, a complex of ground stone artifacts--celts, grooved axes, grinding slabs, manos, and pitted stones (Johnson, 1962). The appearance of ground stone artifacts belies the importance of wood-working and plant food preparation in the late Archaic era. Pottery of Williams Plain varieties (Johnson, 1962), Bear Creek Plain, and bone-tempered wares seems to have been added to late Archaic assemblages without affecting significant changes in traditional patterns or activities.

1. The LaHarpe Aspect. Johnson (1962) defined the LaHarpe Aspect as an Archaic complex bordering the fringe of the Eastern Woodlands and extending throughout East Texas from Houston to southeastern Oklahoma and perhaps extending into western Louisiana and southwestern Arkansas. The complex is identified by flexed burials without grave goods, pitted stones, expanding stem dart points such as Yarborough, Trinity, and Palmillas (early phase), contracting stem dart points such as Gary and Wells (later phase), plain pottery (terminal phase), and polished and ground artifacts (axes, celts, gorgets) (Johnson, 1962). The LaHarpe Aspect is a very broad archeological classification and will no doubt be subdivided into several time and geographic units as more information is assembled. The end of the LaHarpe Aspect coincides with the appearance of abundant ceramics and arrowpoints, no doubt signaling the beginning of a more sedentary, probably agricultural way of life in East Texas.

2. Manton Miller site. The Manton Miller site, located within Cooper Lake in south-central Delta County, was excavated in 1959 by the Inter-Agency Archaeological salvage program (Johnson, 1962). Two areas of the site were excavated disclosing artifacts typical of three separate phases of occupation (LaHarpe Aspect - late and terminal phases - and Alto Focus Caddoan), four human burials, one dog burial, three basin-shaped pits, and seven earthen hearths (Johnson, 1962). Faunal remains included deer, ferret, skunk, raccoon, opossum, dog, terrapin, cottontail, hare, fish, and turkey (?). The presence of deer antler artifacts

implies that the site was occupied during late fall and winter and occupation during other seasons is suspected because of its relatively large size (4 acres), and the presence of daub fragments (suggesting the presence of houses).

(c) The Neo-American Stage. The stage followed the Archaic Stage in East Texas. The division between Archaic and Neo-American is not neat and clear. Archaic survivals are prevalent (Webb, 1958) and indeed there seems to be a fairly lengthy period of time, perhaps from 200-100 B.C. to A.D. 500-1000, when pottery, burial mounds, and other non-Archaic traits were in vogue without any apparently significant alteration in subsistence-settlement patterns, which remained basically Archaic. Some participation in the Southern Hopewellian, or Marksville, interaction sphere by local East Texas peoples during this early Archaic-Neo-American transition is indicated by burial mounds at Jonas Short and nearby at Coral Snake Mound (Jensen, 1968). It is also probable that some Bellevue-like manifestations (cf. Fulton and Webb, 1953), typical of northwestern Louisiana, also may have occurred in East Texas during this time. However, certain trends, namely the continued popularity of the small-thin arrow point over the larger antecedent dart point, the development of a mound-building complex, and the probable integration of horticulture with an efficient collecting-hunting base, led a significant change in local cultures around 900-1000 A.D. From this important dateline, archeologists recognize two broad cultural aspects, Gibson, the earlier, and Fulton, the later (Krieger, 1946). These aspects are considered to mark the indigenous development of the Caddo Indians. Some authorities maintain that this prehistoric Caddoan development had its roots in Mesoamerican and/or Coles Creek (a widespread culture in eastern Louisiana) stimuli, while others insist it came about under its own inertia (Davis, 1970). These views cannot be presently reconciled. The division between Gibson and Fulton aspects formerly hinged on the presence of Southern Cult materials in the former and their absence in the latter. Southern Cult elements, which represent an integrated complex of art forms and motifs in clay, shell, and stone thought to be associated with religious mortuary practices or with the Green Corn ceremony (Waring and Holder, 1945), have not been discovered in Fulton aspect sites and what was formerly recognized as a sharp division between the two aspects is now dissolving into a rather continuous transition.

1. The Gibson Aspect (A.D. 500(?) or 900-A.D. 1200)

a. The Alto Focus. The Alto focus is the first widespread early Caddoan manifestation. It was defined

on the basis of materials from the George C. Davis site (Newell and Krieger, 1949) and amplified later by findings at Smithport Landing (Webb, 1963). Typical pottery types include Holly Fine Engraved, Hickory Fine Engraved, Dunkin Incised, Davis Incised, Weches Fingernail Impressed, Crockett Curvilinear Incised, and Pennington Punctated Incised (Newell and Krieger, 1949: 187), and Carmet Engraved and Wilkinson Punctated (Webb, 1963). Dart points--Gary, Wells, Ellis, and Yarborough--continued, but the Alba arrow point is the major type. Burial goods often include petaloid celts, figurines, ear spools, long-stemmed pipes, Copean "knives," and other minor elements. Burials were made in pits let down into flat-topped mounds (Davis) or in cemeteries (Smithport Landing). Round houses, ranging from 20-50 feet in diameter, were the norm at Davis. Agriculture was practiced and may have been the major source of subsistence. Inter-regional trade is manifest in the appearance of exotic materials, e.g., copper, Catahoula sandstone, kaolin, slate, schist, and porphyries. Settlement patterns are incompletely known, but large ceremonial centers surrounded by a supporting precinct are anticipated. A ranked social structure, economic redistribution, and a priest-chief type of government are also suspected, and the Alto focus may signal the first appearance of Caddoan chiefdoms, sophisticated sociopolitical forms exceeded in complexity only by state-type organizations.

b. The Gahagan Focus. The Gahagan mound, excavated by Webb and Dodd (1939), is the type site of the Gahagan Focus. It is located on the Red River in northwestern Louisiana. It is contemporary with the Alto Focus and has been included by some researchers under that rubric rather than under a separate one. The physical elements of culture, as described for the Alto focus, occur in Gahagan, with some omissions, additions, and local peculiarities. Comparatively, the Gahagan focus is "fancier" than most Alto components. The larger number of ceremonial burial placements differed from the sparse placements at Davis. The "cloud-blower" and frog effigy pipes are so far confined to the Gahagan mound as are the spatulate greenstone celts, stone discoidals, copper-covered wooden rattles, copper human hand effigy and long-nosed god mask, and numerous other items. Webb and Dodd (1939) have argued for Gahagan-Floridian connections, but recent discoveries, including the Mounds Plantation site, make such possible connections rather dubious. The Gahagan complex certainly looks local, a crystallization of a general Alto base in the Red River Valley of northwestern Louisiana around A.D. 1000-1100.

c. The Haley Focus. The Haley focus marks the end of the Gibson aspect; it is estimated to date from the period between A.D. 1200-1400 (Davis, 1970). Haley components

are concentrated in southwestern Arkansas along the Red River and principal affluents. Settlement pattern generally follows the Alto pattern of large, widely-separated mound centers with scattered intervening hamlets. Usually each center has a dominating temple mound and surrounding burial mounds. Mounds were usually erected over "altars" or burned buildings and grave pits were subsequently excavated into them. Burials are extended supine forms and are usually adult males. Burial furniture is plentiful and consists of pottery vessels (Haley Complicated Incised, Crockett Curvilinear Incised, Davis Incised, Dunkin Incised, Hickory Engraved, Spiro Engraved and others), Hayes arrowpoints, elbow and long-stemmed pipes, petaloid and flat celts, and numerous shell artifacts. The Southern Cult iconography is rarely reflected in the Haley focus.

d. The Sanders Focus. The Sam Kaufman site excavated by Harris (1953) dates the first habitation of the site to the 11th century, thus giving us a good example of a Sanders Focus site. This site consisted of a village area about a mile long and ¼ mile wide. Eleven burials were found, including a pit burial of skulls and evidence of a cremation. Two multiple burials which date between A.D. 1300-1500 were recorded and their presence at this late date is interpreted as a continuation of an earlier burial form once more common throughout the Caddoan area. Burials at the Kaufman site show some patterns indicative of ranked status. In multiple burials, most of the individuals were placed in an orderly fashion on the pit floor and above these were laid the bodies of one or two individuals who were apparently of higher status. If this pattern of burial sequence indicates status ranking, females as well as males occupied positions of high status. Cult artifacts include motifs engraved on shell gorgets, engraved human head cameos, and copper-covered earspools. The mounds at the site were not built as temple or burial structures but are the result of midden accumulation. Harris reported pottery types from these burials and lithic artifacts of novaculite which indicate that there was some trade with, or intrusion from, the inhabitants of southwestern Arkansas. Other trade material included turquoise artifacts, probably obtained from the Pueblo Indians of New Mexico and glass trade beads from early white traders. Analysis of the tools and faunal remains from the midden show a heavy reliance on hunting/gathering. This site is listed in the National Register of Historic Places and lies outside of the project area.

2. The Fulton Aspect (1200 A.D. to early historic times). The Fulton Aspect, which includes several late prehistoric and protohistoric foci, superseded the Gibson aspect throughout the Caddoan area, sometime around A.D. 1200. In the main, the Fulton aspect seems to represent a period of cultural

de-evolution at least in the elements of culture which typified the preceding Gibson manifestation. The major losses include ceremonial objects, mound-building, grave richness, and funeral elaboration. The ceremonial center outlying hamlet settlement pattern was replaced by a scattered village-camp pattern set across many environmental zones. Population seems to have dispersed and village autonomity seems to have been the rule. Agriculture may have been of reduced importance, as wild food collecting became of prime importance again. Tribal organization probably replaced the more sophisticated chiefdom sociopolitical forms, but this organizational form set the stage for the appearance of regional confederacies, well known at the beginning of historic times.

a. The Titus Focus. The Titus focus of the Big Bend region of East Texas is a member of the Fulton Aspect. The Titus focus lacks the ceremonial mounds and elaborate burial ceremonialism of the preceding Gibson era. Cemeteries are known and contain extended burials with funeral offerings, typically pottery vessels and arrowpoints. Titus focus pottery types include Bailey Engraved, Belcher Engraved, Belcher Ridged, Bullard Brushed, Harleton Appliqued, Karnack Brushed-Incised, LaRue Neck Banded, Taylor Engraved, Wilder Engraved, and Ripley Engraved. Arrowpoint types include Bassett, Talco, and occasionally Maud, and dart points, Gary and Ellis. Other implements are nutstones, triangular celts, adzes, shell beads, and effigy pendants, and various bone artifacts. Ceramic lip plugs, and clay elbow pipes also occur. Virtually nothing is known about subsistence and architectural features, nor about social or political organization.

b. The Bossier Focus. Webb's (1948) excellent description of the Bossier Focus has not been improved in nearly three decades. The Bossier focus is a widespread expression occurring in northwestern Louisiana, East Texas, and probably southwestern Arkansas. Bossier sites are typically small, are located in the hills and terraces conjoining major river valleys, and rarely, if ever, have accompanying burial mounds. The subsistence base was mixed--hunting, collecting, and probably agricultural. Architectural data are scarce; oval houses are suggested and low sand mounds may have been built. Burials of extended supine form were made in shallow pits in middens with no observable tendency to cluster in cemeteries. Burial furniture, consisting of a few pottery vessels, was sometimes placed near the cranial region. Bossier pottery types include Maddox Engraved, Taylor Engraved, Pease Brushed-Incised, Belcher Ridged, Sinner Linear Punctated, Dunkin Incised, and Bossier Brushed. Other artifacts include elbow pipes, pottery discs, clay figurines, dart and arrowpoints, ground and polished stone items. Most of the material cultural inventory

de-evolution at least in the elements of culture which typified the preceding Gibson manifestation. The major losses include ceremonial objects, mound-building, grave richness, and funeral elaboration. The ceremonial center outlying hamlet settlement pattern was replaced by a scattered village-camp pattern set across many environmental zones. Population seems to have dispersed and village autonomity seems to have been the rule. Agriculture may have been of reduced importance, as wild food collecting became of prime importance again. Tribal organization probably replaced the more sophisticated chiefdom sociopolitical forms, but this organizational form set the stage for the appearance of regional confederacies, well known at the beginning of historic times.

<u>a</u>. <u>The Titus Focus</u>. The Titus focus of the Big Bend region of East Texas is a member of the Fulton Aspect. The Titus focus lacks the ceremonial mounds and elaborate burial ceremonialism of the preceding Gibson era. Cemeteries are known and contain extended burials with funeral offerings, typically pottery vessels and arrowpoints. Titus focus pottery types include Bailey Engraved, Belcher Engraved, Belcher Ridged, Bullard Brushed, Harleton Appliqued, Karnack Brushed-Incised, LaRue Neck Banded, Taylor Engraved, Wilder Engraved, and Ripley Engraved. Arrowpoint types include Bassett, Talco, and occasionally Maud, and dart points, Gary and Ellis. Other implements are nutstones, triangular celts, adzes, shell beads, and effigy pendants, and various bone artifacts. Ceramic lip plugs, and clay elbow pipes also occur. Virtually nothing is known about subsistence and architectural features, nor about social or political organization.

<u>b</u>. <u>The Bossier Focus</u>. Webb's (1948) excellent description of the Bossier Focus has not been improved in nearly three decades. The Bossier focus is a widespread expression occurring in northwestern Louisiana, East Texas, and probably southwestern Arkansas. Bossier sites are typically small, are located in the hills and terraces conjoining major river valleys, and rarely, if ever, have accompanying burial mounds. The subsistence base was mixed--hunting, collecting, and probably agricultural. Architectural data are scarce; oval houses are suggested and low sand mounds may have been built. Burials of extended supine form were made in shallow pits in middens with no observable tendency to cluster in cemeteries. Burial furniture, consisting of a few pottery vessels, was sometimes placed near the cranial region. Bossier pottery types include Maddox Engraved, Taylor Engraved, Pease Brushed-Incised, Belcher Ridged, Sinner Linear Punctated, Dunkin Incised, and Bossier Brushed. Other artifacts include elbow pipes, pottery discs, clay figurines, dart and arrowpoints, ground and polished stone items. Most of the material cultural inventory

is very hard, if not impossible, to separate from Late Archaic materials. The relationship of the Bossier focus to other Caddoan foci is poorly understood as is the evolution of the culture. Sociopolitical characteristics and other details of culture are unknown.

c. The Belcher Focus. The main characteristics of this focus are found at the Belcher Mound site located along the Red River. The site represents a ceremonial and possibly a civil center of a small agricultural community. Belcher focus culture at this and companion sites was undoubtedly derived largely from the Haley focus (Webb, 1959). The nucleus of the Belcher focus existed in the series of mound sites along Red River between the present cities of Shreveport and Texarkana (Webb, 1959). Webb says that the Belcher focus people were unique among Fulton cultures in retaining many traits which characterized the earlier Gibson cultures: ceremonial centers in a major river valley, active mound construction with mound burials as well as habitation, a predilection for polished black pottery with fine line engraving and pigment insertion, extensive use of shell for tools and/or maments, high ceremonialism, persistence of specific cult elements, burial ceremony attended by house destruction and immolation, deep burial pits, rich burial placements, choice of special burial pottery, vestigal use of copper, and extensive trade for exotic materials. Webb goes on to speak about the relationship of the Bossier-Belcher foci: possibly the Belcher focus is the ceremonial expression of the more widespread Bossier focus, since they seem to have a number of traits and several pottery types in common (Webb, 1959).

d. Texarkana Focus. The best description of this focus can be seen at the Knight's Bluff Site which is situated on a high bluff overlooking the Sulphur River northeast of Douglasville in Cass County, Texas. The principal occupation at this site was evidently by a small village of people over a period of several decades (Jelks, 1955). The Texarkana focus was assigned to this site due to the abundance of Texarkana pottery at this site which includes Nash Neck Banded, McKinney Plain, Barkman Engraved, Cass Appliqued, Simons Engraved, Bowie Engraved, Hatchel Engraved, Foster Trailed-Incised, Avery Engraved, and Rattle Bowls. In support of an alinement with early Texarkana Focus is the presence of long-stemmed clay pipes of Gibson Aspect form, which probably are survivals not yet replaced by the short-stemmed elbow pipes affiliated with later phases of the Texarkana Focus and Glendon Focus (Jelks, 1955). The Knight's Bluff Village appears to be sedentary in character due to the excavation of one permanent type house and the relatively large quantity of ceramics. Jelks assumed

that agriculture was practiced although there was no direct evidence of this on the basis that the village was permanent in nature and because remains of agricultural products have been discovered in closely related sites.

(d) Historical-aboriginal

1. First European contact. Historic contact with the Caddo probably first occurred when wandering Jumano bands of traders carried Spanish goods from New Mexico to eastern Texas in the 16th century. About the same time, the DeSoto expedition under the command of Luis de Moscoso encountered Caddo tribes in the Red River area in June of 1542. Here they found the Naguatex, a Caddoan tribe as well as the Hacanac, Nissohone, Nandacao, and Hais. The expedition traveled through Caddo country all the way to the Trinity River, alternately fighting and trading with the tribes they met (Swanton, 1942). Later the same year, the expedition returned through the same country on the way back to the Mississippi River. These isolated instances were probably the only Caddo-European contact until 1685, when La Salle traveled from the Texas coast through Caddo country in his search for the Mississippi River (Woodall, 1969). Following his visit, a period of frequent contact and trade was established between the Caddo and the French.

2. Spanish-French rivalry. In 1691, the Spanish began to counter the French influence by establishing a series of missions in the southern part of the Caddo region among the Hasinai Confederacy (Griffith, 1954). This was soon met by a French countereffect under Bernard de la Harpe at setting up trading posts along the Red River among the Kadohadacho tribes. Thus, the battle lines were drawn between the French sphere of influence in the north and the Spanish sphere in the south. The Caddoan area became an object of national rivalry; the Spanish and French contested each other's claim to trade and christianize among the Indians although congenial relations between the French and Spanish were maintained by the St. Denis and the Re Mezieres. In 1762, the French withdrew their provincial government from northeast Texas and ceded the area of Louisiana to the Spanish, who quickly established alliances with the Kadohadacho. The Texas area itself soon came under Spanish control and the Caddo tribes now traded almost exclusively with the Spaniards. In 1803, after passing for a brief period again into the hands of the French, Louisiana was sold to the United States and the Caddo tribes were investigated and reported by a US government expedition to the Red River in 1806 (Swanton, 1943). At this time, the influx of American pioneers began into the counties of northeast Texas.

3. Protohistoric Caddo culture. The protohistoric Caddo villages first seen by these Europeans were less widely distributed than those of the late prehistoric peoples. The Caddo populations were organized into confederacies consisting of a group of allied tribes living under one government and governed by a supreme chief known as the Xinesi (Woodall, 1969). When contacted by the Europeans, there were two main areas of Caddo population: (1) the region along the Red River along the border of Texas and Oklahoma where the Kadohadacho confederacy was located; (2) the region between the Trinity and Red Rivers where Hasinai confederacy was located; and (3) the region around present-day Natchitoches, Louisiana, some 400 miles south of the Big Bend and over 100 river miles from Caddo Lake where the Natchitoches confederacy was located. The valleys of Cypress Creek and the middle Sabine were unoccupied. Archeological sites of this period contain objects such as glass beads and metallic goods.

(e) Summary of early archeological investigations. Archeological work in the Sulphur River Basin has progressed sporadically since the early 20th century. In the 1930's, extensive excavation was carried out in the Red, Sulphur, Upper Sabine, and Neches River basins under the patronage of the Works Project Administration. Most of the sites dug during this period were burial mounds and campsites. The data collected during the thirties eventually was analyzed and synthesized. Meanwhile, further investigation was taking place under the River Basin Surveys of the Smithsonian Institution. Preliminary surveys and excavations were carried out in reservoir areas of the Sulphur River Basin, as well as other river basins in eastern Texas. In 1958, the Texas Archeological Salvage project was created and continued the River Basin Survey's work in Texas. The Sulphur River Basin was investigated at the proposed Cooper Lake site, but no excavations were carried out.

(2) Recent archeological investigations

(a) General. Recent surveys in the Sulphur River Basin have located a total of 283 sites. These surveys include investigations of the Cooper Lake project area, the channeling operation area near Talco, Texas, and the Wright Patman Lake area. One hundred and ten sites were located in the Cooper Lake area; these sites are listed and described in appendix D (available for review at the New Orleans District office). Ceramic and lithic material from the sites indicated the presence of Archaic through Neo-American culture stages in the Cooper area. The survey conducted at the Wright Patman Lake area revealed 140 sites (East Texas State University, 1971). These sites were also representative

of the Archaic through Neo-American stages. The same types of stages were indicated by archeological data collected in the flood plain of the Sulphur River east of Talco, Texas; these sites are also described in appendix D. Thirty-three sites were located and recorded in this survey. More detailed descriptions of the surveys in the project area follow:

(b) Southern Methodist University Investigations sponsored by the National Park Service

1. SMU 1970

a. An extensive survey of the area was begun in 1970 by a research team from SMU. The survey produced a total of 105 prehistoric sites within and along the periphery of the reservoir project area. Surface scatters of artifacts suggested that the sites in and adjacent to the flood plain represent camps of small hunting and gathering groups subsisting on riverine and flood-plain resources, while sites on the terraces and in the uplands represent activity-specific sites, such as hunting camps and quarrying stations.

b. While 75 percent of the recorded sites were located within and adjacent to the flood plain (meaning the flood plain proper, remnant knolls in the flood plain, and terrace edges), it was suggested that the prehistoric occupation of the area was to maximize the exploitation of resources of riverine and flood-plain nature, with a general disregard for resources located in other environmental zones (terraces, upland edges, and uplands). However, due to the contemporary patterns of bottomland flooding during the late fall and early spring months, it was projected that continuous occupation of the flood-plain sites and a year-round exploitation of the flood-plain resources would have been impossible.

c. An explanatory settlement-subsistence model was formulated: occupation of the area was on a seasonal basis only, and prehistoric populations frequented the flood-plain sites during restricted times of the year to exploit certain plant and animal resources and relocated outside the confines of the reservoir during the remainder of the year.

d. After completion of the site survey, a number of sites were selected for testing to investigate their research potential. Limited testing was conducted at the following five sites: the Society Site (X41HP2), the Finley Site (X41HP30), the Jarrell Site (X41DI12), the McKinney Site (X41DI13), and X41DI59.

2. SMU 1972

a. The discovery of five additional sites during the 1972 field season brought the total number of known sites to 110.

b. A testing program was initiated to evaluate the functional variability between sites of different sizes. The four sites tested during the 1972 summer field season were the Lawson Site (X41HP7), the Cox Site (X41HP37), the Ewing Site (X41DT57), and the Thomas Site (X41DT68). It was determined on the basis of this site testing that flood-plain sites were functionally equivalent, irrespective of site size.

c. The results of these efforts are detailed in the publication "Archaeological Research at Cooper Lake, 1970-1972" (Hyatt, Butler, and Mosca, 1974).

3. SMU 1973

a. During this season, site testing was oriented to the investigation of sites located in different environmental locations. Two flood-plain sites (X41HP37 and X41-DT68), one site on a terrace edge (the Thalya Site, X41DT17), and a site on a remnant knoll (the Manton Miller Site, X41DT1) were selected for study. It was expected that the Miller Site might represent a permanent base camp.

b. The sites tested demonstrated a functional equivalence, despite their environmental locations. Flood-plain and terrace edge sites differed only in the intensity of the occupation, the former being more intensively occupied. This was evidenced in particular by the density of deposits and by the frequency of cultural features (such as hearths, trash pits, and human burials) at flood-plain sites.

c. Although a house structure was located at the Miller Site, the relatively shallow cultural deposit and nature of the artifactual content suggested that this site was simply another seasonally occupied camp.

4. SMU 1974

a. A program of systematic excavation was effected during 1974 to refine the evaluation of functional variability between sites. Special attention was given to the collection of data to clarify problems of:

(1) Occupation seasons

(2) Subsistence base

(3) Intrasite activity patterning

(4) Technological activity patterning

(5) Surface-subsurface artifact distribution correlations

(6) Chronology and cultural affiliations

b. A flood-plain site, the Arnold Site (X41HP34) was selected for extensive excavation. The eastern half of the site was excavated, exposing ten human burials, numerous hearths, and trash pits, giving a considerable insight to the internal organization of activities within a site.

c. The research was simultaneously designed to continue the investigation of the relationships of terrace sites and flood-plain sites.

d. Testing was resumed at the Thalya Site (X41DT17) to reveal a greater depth of deposit along the edge of the site than previously disclosed. A second terrace edge site was tested (X41DT20). This site demonstrated a very shallow cultural deposit, with the usual generalized artifact inventory, suggestive of a short-term season occupation.

5. SMU 1975

a. The 1975 summer field season was primarily dedicated to the completion of the excavation of the Arnold Site and the obtaining of a comparable quantity of data from a terrace edge site, the Ranger Site (X41DT19). Three additional burials were located at the Arnold Site, as well as the hearths, and three more trash pits. No features were located at the Ranger Site, despite the systematic nature of the excavation. This may be attributed to the lack of preservation in the sandy soil or perhaps to the legitimate absence of features there because of the very short term of the occupation. The exceptional preservation of osteological remains at the Arnold Site has enabled the determination of the prehistoric subsistence base and has indicated that the occupation of the site may have been year-round, rather than

restricted to certain seasons of the year. The sandy soil at the Ranger Site was not conducive to the preservation of osteological material, inhibiting the reconstruction of the subsistence base and the season(s) of occupation at this site.

b. The artifact assemblages from these two sites are of comparative value. The Ranger Site provides a late Archaic (perhaps "transitional") inventory of artifacts, while the Arnold Site yields a distinct collection of Neo-American artifacts. It is expected that the comparison of the two will clearly illustrate the technological changes which characterize the occupational periods.

c. Two additional sites were tested during the 1975 field season. The Luna Sites (X41DT36 and X41DT37) are located at the confluence of the South and Middle Sulphur Rivers, one on a remnant knoll and the other at the base of the knoll in the flood plain.

d. The objective of testing the site on the knoll (DT36) was to determine whether or not it represented a base camp, while the testing of the site in the flood plain (DT37) was to verify whether or not the site represented a contemporaneous and associated specialized burial area.

e. A total of ten test pits were distributed across the site in the flood plain (DT37). Three human burials were recovered, along with an artifact inventory suggestive of a temporary campsite, contradicting the assumption that this was a specialized burial area.

f. The testing of the site on the knoll (DT36) was insufficient to fully evaluate its prehistoric function. The deposit proved to be extraordinarily large (covering @ 2,000 square meters) and deep (greater than 70 centimeters). The seven test pits which were distributed over the site were productive in terms of artifact recovery, nonetheless inadequate to isolate the internal organization of the site or to establish its identity as a permanent base camp.

6. SMU 1976

a. The synthesis of the investigations should provide a comprehensive picture of the prehistoric occupation of the area and its relationship to surrounding areas. Plans for the 1976 season (sponsored by the Corps of Engineers) included testing of 14 selected sites identified by earlier investigations.

The Luna Site (X41DT36) on the knoll was among those selected. Investigation of sites in the terrace and upland zones will be stressed, as were sites pertaining to the Archaic occupation, those being relatively unexplored topics.

b. An evaluation of the historical cultural resources was also conducted. A report is currently in preparation.

c. Based on determinations of significance and publication and coordination of the report, appropriate plans may be developed for additional salvage and/or mitigation to be accomplished on resumption of construction.

(c) East Texas State University Investigations

1. Distribution of lithic artifacts. The distribution of lithic artifacts found during the East Texas State University survey appear to be random, without any geographic pattern. Those artifacts which could have been involved in food processing and the fashioning of nonfood procuring implements were noted on both the terrace and knoll sites. The lithic raw materials from these sites seemed to have come from graded Pleistocene gravel beds on the upland terraces south of the Sulphur River. The concentration of ceramic materials on sites in the western end of the survey area might be the result of variables not readily apparent in the current study.

2. Influence of floods on site location. The flooding of the river flood plain is variable. Rainfall in the area can occasionally fall up to 10 inches in 24 hours, causing flash floods. Therefore, occupation of the river flood plain was probably limited to the summer dry season. During the wet months of spring and fall, the flood plain was boggy, making habitation rather undesirable. During this 6-month period, the flood-plain knolls provided an elevated dry area while the surrounding territory could still be exploited. During the months of maximum rainfall, the knolls were isolated by the floodwater and were probably abandoned. Most of the terrace edge sites were within 5 feet above or below the present maximum flood level of the Sulphur River (about 300 feet). Sites along the maximum flood level tend to be larger than those at higher elevations. Four of the five sites containing ceramic material were located near the present flood line. Within the limited scope of the survey, the greatest number of sites was located on the first terrace overlooking the Sulphur River plain. The majority of these sites has easy access to water throughout most of the year. The remaining sites were located on

flood plain knolls, except for one quarry site located on the second terrace between the 340-foot and 350-foot contour.

(d) Site identification. Site numbers for these surveys were recorded under the trinomial system used by the University of Texas at Austin. Plate II-6 shows the general location and relative distribution of sites in the reservoir area.

b. Historical

(1) Historical pattern, communities, and sites. The 11 counties of northeast Texas included in the Sulphur River Basin developed a distinctive settlement pattern. This settlement pattern was influenced by physical, locational, historical, and economic factors. The approximate western boundary of this region is the 30-inch rainfall line dividing the wooded eastern section of Texas and the western plains section. This was also the boundary of the two distinct aboriginal cultures: the nomadic Plains Indians (such as the Comanches) penetrated the east only to follow buffalo or to loot the villages of the cultivator Indians. This eastern region was physically suited to a village-dwelling cultivating settlement type. Rainfall was more dependable, the climate was mild with a long growing season, small game was abundant, and there was a good supply of fruits, nuts, acorns, and herbs. The predominant village-dwelling tribes were Caddoes, who cultivated corn, beans, calabashes, watermelons, and sunflowers. The route of the "Caddo Trace" between Caddo villages near Shreveport and their prairie hunting grounds to the west ran diagonally across present Hopkins County and followed the divide between the Sulphur and Sabine Rivers. The western boundary of the Caddoes remained long after their departure and the disintegration of tribal identity. In the treaty of 1843, this same western boundary was used as the division between the Indians and the white Americans. Provisions of the treaty included a line of trading posts just beyond the ancient line of Caddoan villages. During 1849-50 a line of military posts was established paralleling the prehistoric frontier between villagers and nomads. This aboriginal frontier later became a battleground between the Plains Indians and civilization.

(a) Early exploration. Early Spanish explorers such as Coronado and DeSoto entered this area, followed, in the early 18th century, by French explorers and traders who encountered the Caddoes along the Red River. The French established relations with the Indians and made some settlements in the area, raised crops, and traded with the Indians. In 1797 the Red River Region was mapped by Philip Nolan. His map was passed on to a Baron Carondelet and then to the Spanish governor of New Orleans. Spanish

settlement did not occur in this northeastern region, although the area was claimed by Spain and later by Mexico, and administered loosely as a part of the province of Texas.

(b) Early settlement. The first Anglo-Americans entered the East Texas region early in the 19th century. Many explorers, traders, and settlers moved up the Red River. Settlements occurred along the Red River and the old aboriginal frontier, eventually spreading throughout the 12 counties of the Sulphur River Basin. The first American settlers arrived in 1814 or 1815, settling on both sides of the Red River. One of the first settlements was at Jonesboro (no longer in existence). In 1818 a ferry was established near the mouth of the Kiomatia River by Henry Jones at the settlement bearing his name. This area was considered to be a part of the Louisiana Purchase and the territory of Missouri. In 1819 the Adams-Deonis Treaty established the Spanish-American boundary, but it was more than 20 years (including three changes in Texas sovereignty) before the line was surveyed from the Sabine to the Red River. In 1819 the territory of Arkansas was organized and superseded Missouri's claim to the area. The settlers along both sides of the Red River considered themselves a part of the United States and accepted the authority of the Arkansas Territory. Settlers on the north side of the Red River were ordered to move to the south side when the United States Government set aside territory for Indians. Some of the settlers did move south of the Red River, but others wrote to the government in Washington. They did not want to give up their homes and their fields. The United States Government made a new survey and placed the Indian lands farther to the west. These settlements then became a part of Arkansas, first as a part of Hemstead County and later of Miller County. Jonesboro was designated the county seat of Miller County, Arkansas, in 1822 and county courts were held at intervals at Jonesboro.

(c) Texas becomes a republic. After 1826 settlement south of the Red River was under the Milam and Wavell colonization contracts. Ben Milam received a colony grant from Mexico in 1826 after helping Mexico gain independence from Spain. Milam located a settlement at Lost Prairie (now in Miller County, Arkansas). All settlements along the Red River were under the jurisdiction of Nacogdoches, but Mexico did not enforce its jurisdiction. The great confusion in the location of the Milam and Wavell colonies left the region open to squatter sovereignty. Some settlers paid taxes in Arkansas while sending representatives to the Texas convention in 1835-36. In one of many such cases a brother was representing the district in the Arkansas constitutional convention while another brother sat on the councils of the Republic of

Texas. Texas became a republic the same year, 1836, that Arkansas became a state. The republic adopted the Red River County into its area. However, until 1838, Arkansas and Texas courts were held at Jonesboro. Clarksville had citizens paying taxes to both Arkansas and Texas, and the area was loosely administered by both governments. The boundary line was finally demarcated several years after Texas became a republic. Before the revolution, the area was known as the Red River District and after the constitution, the Red River County.

(d) Civil War. During the Civil War this northeast region was strongly secessionist. Soldiers from the counties were assigned to the Red River frontier and took over military posts in Indian territory as well as being sent east. Texas cattle were driven across this region for the Confederate troops in the east.

(e) Reconstruction Era. There was a heavy surge of immigration from the Old South in the 1870's and 1880's due to Reconstruction, the depressed state of the south, and the loss of property, both land and slaves. This was resurgence of the antebellum migration. Settlers came by covered wagon, boat, and railroad. However, now there were no free lands and these immigrants were without capital to establish themselves independently. This was the Cotton Belt moving westward, and economic conditions intensified this pattern of life and economy based upon cotton. The migration of the 1870's and 1880's was the last great movement of population into East Texas until the oil boom of the 1930's. For many years, the region had an economy of barter and subsistence farming. With better transportation and the development of ginning facilities, cotton became the chief cash crop. The possibility of an easy subsistence economy created a lack of incentives and was a handicap to growth and development. The one-crop cotton economy, inertia to change, the banking and commercial structure, and racial habits retarded the transition to a better agricultural economy. Only when the soils were depleted and cotton was produced more efficiently elsewhere, did the predominant agricultural pattern change to livestock and commercial crops.

(f) The coming of the railroad. The development of railroads in the late 19th century created numerous new towns, the change of location of some towns, and the disappearance of others. Many of the older towns have also had name changes. Several small counties were created because of the prospect of railroad development. Various industries developed rapidly with the improved transportation facilities. The industries were based upon the resources of the region: lumbering and furniture, cotton ginning and cottonseed, pottery, livestock, and services.

(g) Summary. The settlement pattern of the 12 counties in the Sulphur River and Red River region was influenced by several factors. First, physically the region was suitable for an easy subsistence economy. With climate and soils somewhat similar to the Old South, there was an easy transfer of the cotton plantation economy. Second, locationally the region was the gateway to Texas, and many settlers and adventurers settled in this region rather than migrating farther west or southwest. The region was bounded by the Red River water route on the east and north. The land route from Little Rock proceeding southwestward into Texas crossed this region. Third, historically the region had been partially explored early. However, the land was never occupied by the French, Spanish, or Mexicans and provided a free area for migrants from the United States. Colonization grants provided inducements for immigration. The adventure of fighting against Mexico for Texas and for the United States, plus the inducement of land grants for military services rendered, enticed others to come to Texas. Fourth, economic factors influenced the settlement of this northeast Texas region. The economic depression of 1837 saw migrations from the United States with the offer of free lands in the Texas Republic. Southern farmers with their slaves moved the Cotton Belt westward. After the Civil War, during the Reconstruction, and in the Depression of 1873, southern farmers again made a resurgence of the ante-bellum migration. The Cotton Belt moved westward into Texas although free lands no longer existed. The cotton plantation economy and way of life continued even after slaves were emancipated. As in the Old South, the one-crop economy depleted the soils. However, change of agricultural patterns was slow to develop. Many of the descendants of the original settlers still remain in the region. The development of towns went through several stages. First, there was the development of trading posts and military forts. Secondly, towns developed along routes of migration. Thirdly, some towns created as counties were organized. Finally, with the coming of the railroads, new towns appeared and old towns were abandoned or relocated.

(2) National Register of Historic Places. The National Register of Historic Places dated 1 February 1977 and monthly supplements through March 1977 have been consulted for the 11 Texas counties and one Arkansas county in the basin to be affected by the selected plan. Seventeen cultural sites were noted; however, all are outside of the immediate project area. Sites included in the National Register of Historic Places are listed below:

County/State	City	Historical Place
Bowie, Texas	Texarkana	Draugh-Moore House
Bowie, Texas	Texarkana	Offenhauser Insurance Building
Bowie, Texas	Texarkana (vicinity)	Texarkana Phase Archeological District
Bowie, Texas	Texarkana (vicinity)	Roseborough Lake Site
Fannin, Texas	Bonham	The Sam Rayburn House
Hunt, Texas	Greenville	Post Office Building
Lamar, Texas	Paris	Samuel Bell Maxey House
Lamar, Texas	Faulkner (vicinity)	A. C. Makin Archeological Site
Miller, Arkansas	Texarkana	Orr School
Miller, Arkansas	Texarkana	Dean House
Red River, Texas	Blakeney (vicinity)	Sam Kaufman Site
Red River, Texas	Clarksville	Smathers-DeMorse
Red River, Texas	Kiomatia (vicinity)	Kiomatia Mounds Archeological District

Sites with pending nomination to the National Register of Historic Places are listed below:

County/State	City	Historical Place
Franklin, Texas	Ozark (vicinity)	Deane Summer House
Hopkins, Texas	Sulphur Springs	Hopkins County Courthouse
Hunt, Texas	Kingston (vicinity)	Site of Birthplace of Audie Murphy
Titus, Texas	Winfield (vicinity)	Hale Mound Site

(3) Historical Markers. Historical Markers, as compiled by the Texas State Historical Survey Committee (published by Texas Historical Foundation, 1971) for the 11 Texas counties within the Sulphur River Basin are presented in appendix E, which is available for review at the New Orleans District office. None of these sites are located in the immediate project area.

2.08 SOCIOECONOMIC ELEMENTS

a. Economic elements

(1) Area of economic impact. For purposes of this report, the area of economic impact, or study area, includes the Texas counties of Bowie, Camp, Cass, Delta, Fannin, Franklin, Hopkins, Hunt, Lamar, Morris, Rains, Red River, Titus, and Wood.

(2) Land and its use. As is reported in preliminary data to the latest published Census of Agriculture (1974), the

total land area of the 14 counties included in the study area is approximately 5,538,000 acres or about 8,653 square miles. In 1974 more than 3,463,000 acres, over 62 percent of the total area, were in farms. Of this farm area, 582,000 acres were harvested cropland, consisting mainly of 281,700 acres of hay crops, 91,800 of cotton, 86,000 of sorghums, and 42,400 acres of soybeans. An additional 964,300 acres of cropland were used only for pasture. Eight of the counties included in the study area (Bowie, Camp, Cass, Franklin, Morris, Red River, Titus, and Wood) have significant amounts of commercial forest land, totaling 1,566,800 acres in 1965 (US Forest Service, "East Texas Piney Woods" 1967). This figure includes some woodland on farms. The study area is not highly urbanized although Bowie County is part of the Texarkana Standard Metropolitan Statistical Area. About 59 percent of the urban population in 1970 was located in the cities of Texarkana (Texas part, population 30,497), Paris (23,441), Greenville (22,043), and Sulphur Springs (10,642).

(3) General economic profile

(a) Agriculture. As is indicated by the large amount of acreage devoted to the production of hay crops and the amount of cropland used only for pasture, agricultural emphasis in the study area is in the production of livestock and livestock products. This has been a developing trend over the past several decades. In 1949, the value of all farm products sold in the study area totaled $63.6 million, with $43.5 million resulting from the sale of crops. More than $40.0 million was from the sale of cotton. By 1969, however, crops decreased to $19.4 million of the $115.6 million value of all farm products sold. Cotton decreased to $5.6 million, while the sale of hay crops amounted to $4.4 million and grains $4.7 million. The value of livestock and livestock products sold has increased from $20.1 million in 1949 to $96.2 million in 1969. Farms with sales of $2,500 or more marketed beef cattle and calves valued at $43.3 million. Dairy products accounted for more than $30.3 million, poultry and poultry products for $9.6 million, and dairy cattle and calves for $3.8 million. Furthermore, preliminary data for 1974 indicate continued predominance of the production of livestock and related products in the study area agricultural sector (table II-22).

(b) Forest products. The eight counties previously mentioned as having substantial commercial forest land has a growing stock volume of 875.1 million cubic feet in 1971 (US Forest Service, "Timber Resource Statistics for Mid-south Counties, 1971"). This represented 8.7 percent of the total stock in the east Texas area, as delineated by the US Forest Service. In 1970 removals of

Table II-22

Agriculture Data
(Dollars)

County	Value of All Farm Products Sold				Value of All Crops Sold				Value of All Livestock and Livestock Products Sold			
	1949	1959	1969	1974	1949	1959	1969	1974	1949	1959	1969	1974
Bowie	3,915,655	7,474,179	12,369,053	[illegible]	[illegible]	[illegible]	2,424,895	[illegible]	2,108,629	5,913,019	9,944,153	13,339,000
Camp	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	763,569	3,577,866	11,646,000
Cass	2,353,217	3,068,313	3,825,372	5,133,000	1,558,977	576,926	418,349	1,292,000	794,240	2,489,387	3,406,023	3,572,000
Delta	4,599,053	4,397,738	3,864,891	4,742,000	[illegible]	2,952,675	1,506,394	1,996,000	727,025	1,445,063	2,358,557	2,744,000
Fannin	13,339,637	[illegible]	10,617,492	[illegible]	[illegible]	[illegible]	4,192,995	10,644,000	2,007,722	4,025,497	[illegible]	6,257,000
Franklin	1,766,633	[illegible]	6,030,161	9,643,000	[illegible]	[illegible]	245,129	967,000	1,088,910	1,598,073	5,785,032	8,643,000
Hopkins	6,947,436	11,397,450	25,739,218	41,020,000	[illegible]	1,318,611	599,778	1,533,000	3,487,504	10,078,839	25,139,440	39,479,000
Hunt	[illegible]	10,052,685	9,004,098	12,303,000	[illegible]	6,269,977	2,712,025	5,719,000	2,190,193	3,782,688	6,292,073	6,579,000
Lamar	8,661,606	9,117,330	11,244,760	16,303,000	[illegible]	3,505,965	2,782,516	6,830,000	2,239,143	5,611,365	8,462,244	9,469,000
Morris	936,719	2,799,067	2,340,344	3,751,000	610,449	229,068	517,128	424,000	326,270	2,570,999	1,823,216	3,294,000
Rains	1,592,976	1,374,302	2,859,547	4,717,000	[illegible]	[illegible]	390,231	481,000	498,247	712,245	2,469,316	4,231,000
Red River	[illegible]	5,100,169	10,113,581	13,329,000	[illegible]	1,329,430	1,524,494	3,927,000	[illegible]	[illegible]	8,589,087	9,867,000
Titus	[illegible]	[illegible]	5,338,826	8,549,000	[illegible]	[illegible]	434,352	909,000	[illegible]	1,755,783	5,104,474	7,609,000
Wood	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,152,940	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Study Area	63,592,794	74,066,423	115,579,927	178,725,000	[illegible]	26,333,955	19,377,438	41,086,000	20,122,170	47,232,438	96,202,489	136,809,000
State	[illegible]	2,138,880,646	3,292,626,939	5,661,427,000	[illegible]	1,137,365,495	1,003,667,622	2,170,015,000	615,729,119	971,495,151	2,284,887,537	3,484,570,000

Source: US Department of Commerce, Bureau of the Census, "Census of Agriculture," 1954, 1964, 1969, 1974 (preliminary).

growing stock timber amounted to 23.8 million cubic feet or 5.3 percent of the area total. For the same year the timber products output in the study area was 17.1 million cubic feet or 5.1 percent of that for east Texas. Pine makes up most of the softwood products and oak the hardwood products. About 80 percent of the 13.8 million cubic feet of softwood products was pulpwood. Of the total hardwood products, only 31 percent comprised pulpwood, with 27 percent sawlogs and 42 percent other products such as veneer logs and fuelwood. In 1975 the total study area industrial roundwood production was 30.1 million cubic feet, or 7 percent of the comparable east Texas area total.

(c) Mineral resources. According to the preprint from the 1973 Bureau of Mines Minerals Yearbook "The Mineral Industry of Texas," the mineral resources developed in the study area include petroleum, natural gas, natural gas liquids, iron ore, clays, sand, and gravel. in 1973 the value of mineral production in Wood, Franklin, and Cass Counties accounted for more than 89 percent of the total reported value of mineral production in the study area. No production was shown in Delta, Fannin, or Lamar Counties. In Wood County the value of mineral production, primarily petroleum, natural gas liquids, and natural gas amounted to $206.7 million. The value of production of these minerals in Cass, Franklin, and Hopkins Counties totaled $23.5 million, $20.0 million, and $12.2 million, respectively. Petroleum and natural gas production in Titus County approximated $10.3 million. Iron ore was the single important mineral produced in Morris County; the value of its production was withheld from the 1973 Bureau of Mines report to avoid disclosure of individual company confidential data. However, the 1972-1973 Texas Almanac reported the average annual value of mineral extractions in Morris County in the 3-year period from 1967 through 1969 to have been $6.5 million. Value of mineral production for selected years is shown in table II-23.

(d) Manufacturing. Data for Delta, Morris, and Rains Counties were withheld from the latest available Census of Manufactures (1972) to avoid disclosure of figures for individual companies; however, information on the remaining counties in the study area reveals some indication of manufacturing trends. Manufacturing employment in the counties reported totaled 15,900 in 1963 and 21,600 in 1972, an increase of some 36 percent. The value added by manufacturing in the study area (again excluding Delta, Morris, and Rains Counties) increased over percent, from $143.1 million in 1963 to $336.1 million in 1972. Manufacturing activities in Delta and Rains Counties are a relatively minor part of the study area total; however, a major steel plant in Morris County has a significant impact on the economy of the study area.

Table II-23

Value of Minerals for Selected Counties in the Sulphur River Basin, Texas, 1953-72

County	1953	1955	1957	1959	1961	1963	1965	1967	1969	1971	1972	1973
						Year						
	Dollars ($1,000's)											
Bowie	1,309	321	369	W	W	428	134	123	82	377	363	399
Camp	346	793	632	852	1,119	1,706	2,995	2,704	2,748	3,254	2,987	3,420
Cass	2,206	3,460	7,229	8,180	7,373	10,655	13,782	16,343	22,786	20,822	21,292	23,506
Delta	-	-	-	-	-	-	-	-	-	-	-	-
Fannin	-	27	-	W	-	-	-	-	-	-	-	-
Franklin	12,802	14,004	11,382	12,313	17,686	11,717	13,378	11,552	11,353	19,344	18,191	19,985
Hopkins	7,904	7,939	5,759	5,935	5,741	4,840	8,064	6,965	6,988	11,731	11,239	12,215
Hunt	123	70	49	32	20	186	146	157	133	182	132	170
Lamar	-	14	35	-	-	-	-	-	-	-	-	-
Morris	-	-	W	W	W	W	W	W	W	W	W	W
Rains	-	-	-	-	-	-	664	1,661	315	1,013	W	1,384
Red River	17	7	45	82	118	77	66	102	89	73	67	67
Titus	14,056	12,174	12,460	10,029	13,866	13,932	11,952	13,140	13,869	9,556	9,578	10,254
Wood	75,939	68,625	66,123	52,101	48,672	52,100	55,070	67,873	91,662	137,859	168,893	206,678
Region	114,702	107,434	104,083	89,524	94,595	95,641	106,251	120,620	150,025	204,211	232,742	278,078

W - Withheld to avoid disclosing individual company data.
Source: Bureau of Mines, "The Mineral Industry of Texas," Minerals Yearbook, US Department of Interior, Washington, DC. 1953-1973.

(e) Transportation. A network of Federal, state, and local highways, several railroads, and several airfields provide transportation throughout the study area. There are currently no navigable waterways that support a significant magnitude of waterborne commerce. The upstream 42.2-mile segment of 66-mile long Cypress Bayou and Waterway between Jefferson, Texas, and Shreveport, Louisiana, is navigable but isolated at mile 23.8 by Caddo Lake Dam; the last reportable traffic tonnage was recorded in 1972. This waterway and a navigation lock for Caddo Dam has been included in an authorization for construction of a barge channel from Shreveport, Louisiana, to Daingerfield, Texas, as a reach of the Red River Waterway. Major highways include US Highways 67, 80, and 82 and Interstate 30, running east and west, and US 59, 69, 259, and 271, and Texas Highways 24 and 37, extending north and south. The study area is served by lines of the St. Louis Southwestern Railway Lines, Kansas City Southern Railway, Missouri Pacific Railway, Southern Pacific Railway, St. Louis-San Francisco Railway Company, Atchison, Topeka, and Santa Fe Railway Company, and Missouri-Kansas-Texas Railroad Company. Airfields are scattered throughout the study area with commercial passenger service available at Paris and Texarkana.

(f) Commercial activity

1. Wholesale. According to the Census of Business, wholesale trade in the study area increased from about $198 million in 1963 to $516 million in 1972. This represented a very minor increase in the area's percentage of the state total, from 1.1 to 1.2 percent. As the population of the study area in 1970 represented about 2.7 percent of the state total, it can be determined that wholesaling activity is lagging.

2. Retail. The volume of retail sales in the study area more closely parallels the level of population, relative to the state total. Retail sales increased from $321 million in 1963 to $627 million in 1972. Texarkana (Texas part), Paris, and Greenville accounted for 43 percent of this 1972 total. By comparison, population of these three cities in 1970 accounted for only 25 percent of the study area total.

3. Selected services. Receipts from customers for selected services in the study area in 1963 totaled $32 million or 1.7 percent of the state total. By 1972 receipts had increased to $60 million; however, the percentage share of the state total had dropped to 1.1 percent. Personal services, such as laundries, barber shops, shoe repairs, etc. comprise the greatest

number of establishments. Auto repair and services are next in number of establishments.

(4) Population and income

(a) Population. Although moderate industrial expansion has occurred in recent years, the economic base of the study area has remained largely agrarian and has not generated increased employment opportunities or population growth over the past 3 decades. Table II-24 illustrates urban growth and population trends in the study area and in the state from 1940 to 1970. Bowie and Morris Counties are the only two counties in the study area which experienced overall increases in population during the 30-year period. Whereas growth rate of the state's population has been greater than the national rate, the study area has had a net population loss since 1940. From 1960 to 1970 the population of the study area grew at a relatively slow rate despite a net inmigration of 1.2 percent. Most of this increase was in Hunt County, in close proximity to the city of Dallas. The State of Texas had net inmigration of 1.5 percent over the same 10 years.

(b) Income. Table II-25 illustrates regional income, source of income, and percent change in total income by counties for Northeast Texas, 1963-64 and 1968-69. Of the 12 counties for which we have statistics, Franklin is the only one experiencing a decline in total income (-3.8 percent). This is due solely to the decline in production of minerals. Table II-26 illustrates the per capita personal income of counties in the study area, the state, and the United States. The per capita personal incomes of counties in the study area are well below those of the state and Nation. Seven of the 14 counties in the project area qualified as of 1 February 1975 as redevelopment areas under Title IV of the Public Works and Economic Development Act of 1965 as amended (table II-27).

b. Sociological elements

(1) General. Mr. Raghu D. Singh, Associate Professor of Sociology at East Texas State University, conducted two attitudinal surveys within the basin. The first survey included community leaders within the 12 county region forming the boundary for discussion of the environmental elements plus a sample of the residents of the reservoir project area (East Texas State University, 1971). The residents of the project area below the damsite were not included in this sample, therefore, a second survey was conducted to include these residents (East Texas State University, 1972). For clarity, the two studies are discussed separately.

Table 11-24

Population Trends

Counties	TOTAL 1940	TOTAL 1950	TOTAL 1960	TOTAL 1970	URBAN 1940	URBAN 1950	URBAN 1960	URBAN 1970
Bowie	-	61,966	59,971	67,813	-	30,004	35,822	43,132
(old urban definition)	50,208	61,966	-	-	17,019	27,441	-	-
Camp	10,285	8,740	7,849	8,005	2,916	3,142	3,796	3,844
Cass	33,496	26,732	23,496	24,133	-	3,782	4,076	5,007
Delta	12,858	8,964	5,860	4,927	2,537	-	-	-
Fannin	41,064	31,253	23,880	22,705	6,349	7,049	7,357	7,698
Franklin	8,378	6,257	5,101	5,291	-	378	702	855
Hopkins	30,274	23,490	18,594	20,710	6,742	8,991	9,160	10,642
Hunt	48,793	42,731	39,399	47,948	18,694	20,616	24,876	31,577
Lamar	50,425	43,033	34,234	36,062	18,678	21,643	20,977	23,441
Morris	9,810	9,433	12,576	12,310	-	-	3,133	2,630
Rains	7,334	4,266	2,993	3,752	-	-	-	-
Red River	26,769	21,851	15,682	14,298	4,095	4,353	3,851	3,346
Titus	19,228	17,302	16,785	16,702	4,528	6,342	8,027	8,877
Wood	24,360	21,308	17,653	18,589	3,223	5,760	5,783	6,135
State								
Texas	-	7,711,194	9,579,677	11,196,730	-	4,838,060	7,187,470	8,920,946
(old urban definition)	6,414,824	7,711,194	-	-	2,911,389	4,612,666	-	-

Counties	PERCENT URBAN 1940	1950	1960	1970	URBAN PERCENT CHANGE 1940-50	1950-60	1950-60	RURAL 1940	1950	1960	1970	RURAL PERCENT CHANGE 1940-50	1950-60	1950-60
Bowie	-	48.4	59.7	63.6	-	19.4	20.4	-	31,962	24,149	24,681	-	-24.4	2.2
(old urban definition)	33.9	44.3	-	-	61.2	-	-	33,189	34,525	-	-	4.0	-	-
Camp	28.4	35.9	48.4	48.0	7.8	20.8	1.3	7,369	5,598	4,053	4,161	-24.0	-27.6	2.7
Cass	-	14.1	17.3	20.7	-	7.8	22.8	33,496	22,950	19,420	19,126	-31.5	-15.4	-1.5
Delta	19.7	-	-	-	-	-	-	10,321	8,964	5,860	4,927	-13.1	-34.6	-15.9
Fannin	15.5	22.6	30.8	33.9	11.0	4.4	4.6	34,715	24,204	16,523	15,007	-30.3	-31.7	-9.2
Franklin	-	6.0	13.8	16.2	-	85.7	21.8	8,378	5,879	4,399	4,436	-29.8	-25.2	0.8
Hopkins	22.3	38.3	49.3	51.4	33.4	1.9	16.2	23,532	14,499	9,434	10,068	-38.4	-34.9	6.7
Hunt	38.3	48.2	63.1	65.9	10.3	20.7	26.9	30,099	22,115	14,523	16,371	-26.5	-34.3	12.7
Lamar	37.0	50.3	61.3	65.0	15.9	-3.1	11.7	31,747	21,390	13,257	12,621	-32.6	-38.0	-4.8
Morris	-	-	24.9	21.4	-	-	-16.1	9,810	9,433	9,443	9,680	-3.8	0.1	2.5
Rains	-	-	-	-	-	-	-	7,334	4,266	2,993	3,752	-41.8	-29.8	25.4
Red River	15.3	19.9	24.6	23.4	6.3	-11.5	-13.1	25,674	17,498	11,831	10,952	-31.8	-32.4	-7.4
Titus	23.5	36.7	47.8	53.1	40.1	26.6	10.6	14,700	10,960	8,758	7,825	-25.4	-20.1	-10.7
Wood	13.2	27.0	32.8	33.0	78.7	0.4	6.1	21,137	15,548	11,870	12,454	-26.4	-23.7	4.9
State														
Texas	-	62.7	75.0	79.7	-	48.6	24.1	-	2,873,134	2,392,207	2,275,784	-	-16.7	-4.9
(old urban definition)	45.4	59.8	-	-	58.4	-	-	3,503,435	3,098,528	-	-	-11.6	-	-

Source: US Department of Commerce, Bureau of the Census, "Numbers of Inhabitants, Texas," 1950, 1960, 1970.

Table II-25

Income Data By County and Industry
(In Thousands of Dollars)

County	Total Income 1963-64	Total Income 1968-69	% Change	Manufacture 1963-64	Manufacture 1968-69	Minerals 1963-64	Minerals 1968-69	Agriculture 1963-64	Agriculture 1968-69	Trade and Services 1963-64	Trade and Services 1968-69
Bowie	40,727	49,231	20.9	17,410	15,581	441	151	6,743	9,160	16,133	24,339
Camp	4,357	10,152	133.0	1,374	3,014	932	2,835	1,155	3,065	896	1,238
Cass	14,265	20,380	42.9	645	1,408	7,932	11,860	2,701	3,206	2,987	3,906
Delta	5,041	5,585	10.8	5	79	-	-	4,460	4,616	576	890
Fannin*	-	-	-	-	-	-	-	-	-	-	-
Franklin	18,741	18,150	-3.8	539	849	16,007	14,113	1,715	2,626	480	562
Hopkins	23,758	37,040	55.9	4,681	9,282	5,644	7,167	10,368	14,822	3,065	5,769
Hunt*	-	-	-	-	-	-	-	-	-	-	-
Lamar	30,924	43,385	40.3	13,640	22,639	-	-	9,165	9,502	8,119	11,244
Morris	60,167	63,797	6.0	49,229	47,772	6,528	10,731	2,155	1,932	2,255	3,361
Rains	1,271	2,479	95.0	-	1[illegible]	-	456	1,163	1,539	108	471
Red River	8,393	10,998	31.0	1,333	1,705	104	71	5,423	7,253	1,533	1,969
Titus	22,391	28,746	28.4	5,428	8,089	10,833	11,792	1,835	3,188	4,295	5,677
Wood	58,574	67,804	15.8	1,839	3,489	49,470	54,080	3,916	6,138	3,349	4,097
Study Area	288,609	357,747	23.0	96,123	113,921	97,891	113,256	50,799	67,047	43,796	63,523

*Statistics not available on these counties.

Source: Office of the Governor, Division of Planning Coordination, "An Input-Output Study of the Economy of Northeast Texas," April, 1972.
Unpublished work sheet from State Comptroller Office, Austin, Texas.

Table II-26

Per Capita Personal Income
(Dollars)

Counties	1959	1969	1973
Bowie	1,456	3,559	4,052
Camp	953	2,502	3,350
Cass	1,055	2,669	3,193
Delta	1,130	2,318	3,455
Fannin	1,327	2,544	3,468
Franklin	1,127	2,573	3,137
Hopkins	1,490	3,017	3,779
Hunt	1,612	3,167	3,869
Lamar	1,412	2,721	3,661
Morris	1,222	3,508	4,758
Rains	864	2,640	3,022
Red River	974	2,122	3,344
Titus	1,300	2,666	3,640
Wood	1,382	2,686	3,480
Texas	1,908	3,341	4,558
United States	2,160	3,733	5,041

Source: US Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April, 1975.

US Department of Commerce, Bureau of Economic Analysis, "Per Capita Personal Income SMSA's, Counties and Parishes, Lower Mississippi Region and Adjacent States, 1929-1970," 1972.

US Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States, 1962*, 1962.

Table II-27

Redevelopment Areas

County	Title	Criteria for Qualification*	Date of Qualification
Bowie	IV	(8)	4-21-71
Camp	-	-	-
Cass	IV	(4)	4-21-71
Delta	IV	(2)	1-28-66
Fannin	IV	(2)	4-08-66
Franklin	-	-	-
Hopkins	-	-	-
Hunt	-	-	-
Lamar	-	-	-
Morris	IV	(8)	9-27-74
Rains	IV	(2)	1-31-66
Red River	IV	(2)	1-18-66
Titus	-	-	-
Wood	-	-	-

*(2) Low median family income

(4) Unusual and abrupt rise in unemployment resulting from the loss, removal, curtailment, or closing of a major employment source.

(8) Substantial unemployment (areas qualifying under this criterion prior to September 27, 1974 were known as Title I areas).

(2) Sociological analysis of community leaders of the basin and residents of the reservoir project area. The leaders of all major communities in the Sulphur River Basin were selected through a snowball or chain-referral technique which is widely used by sociological researchers. Those community leaders who were named by two or more of the respondents were included in the sample. In addition, the names of those community residents who occupied leadership positions in the Soil and Water Conservation Districts or on any other water management board of directors were included in the sample. A 5-percent sample of all the residents of the reservoir area was selected through systematic random sampling procedures. The reservoir area included the southwest portion of Delta County, the northwest portion of Hopkins County, and the northeast portion of Hunt County. This is the area that was considered to be under direct economic influence of the proposed lake. In all, 269 community and water management leaders and 84 other residents were interviewed during this survey (refer to paragraph 4.02a(1)(d)1 on page IV-10).

(a) Demographic characteristics. Examination of the frequencies presented in table II-28 reveals a profile of respondents as being middle-aged males of moderate education and residentially stable urban dwellers. The dominant race represented in the sample was Caucasian with the remainder being classified as Negro.

1. The majority of the respondents (91.5 percent) were married and the remaining 8.5 percent classified themselves as single, divorced, or widowed. Owing to the relatively high age, a majority (57.2 percent) of the households were composed of two or less members. The next highest percentage (33.1 percent) consisted of homes of three or four members.

2. It was found that a majority of the respondents were engaged in nonfarm occupations and that only about 25.0 percent were engaged in some type of farming operation. The fact that 72.8 percent of the respondents were high school graduates and that 26.0 percent of these received college degrees might account for the relatively small percentage involved in farming occupations only.

3. Approximately 92 percent of the sample owned their own homes. The houses ranged in value from below $9,999 to $60,000 and above. The most frequently occurring value was between $10,000 and $29,999. Land ownership was prevalent among more than two-thirds of the respondents; however, only 5.7 percent of the respondents owned 1,000 acres or more.

Table II-28

Selected Demographic and Socioeconomic Characteristics of the Respondents

Characteristic	Number	Percent
Residence		
In Town	253	71.7
Rural - Nonfarm	37	10.5
Farm	63	17.8
Total	353	100.0
Years Lived in Community		
All My Life	201	56.9
Migrant	152	43.1
Total	353	100.0
Age (Years)		
0-29	15	4.3
30-34	16	4.5
35-39	34	9.6
40-44	26	7.4
45-49	52	14.7
50-54	42	11.9
55-59	53	15.0
60-64	47	13.3
65-69	30	8.5
70 or more	38	10.8
Total	353	100.0
Sex		
Male	336	95.2
Female	17	4.8
Total	353	100.0
Race		
White	347	98.3
Nonwhite	6	1.7
Total	353	100.0
Marital Status		
Married	323	91.5
Single	10	2.8
Widowed	14	4.0
Divorced	6	1.7
Total	353	100.0

Table II-28 (Cont'd)

Characteristic	Number	Percent
Size of Household		
1-2	202	57.2
3-4	117	33.1
5-6	23	6.5
7-8	3	0.9
9 or more	8	2.3
Total	353	100.0
Occupation		
Farm Only	66	18.7
Nonfarm Only	216	1.2
Farm and Nonfarm	24	6.8
Retired or No Work	47	13.3
Total	353	100.0
Years of Education		
16+	39	11.0
16	53	15.0
13-15	68	19.3
12	97	27.5
9-11	53	15.0
1-8	43	12.2
Total	353	100.0
Home Ownership Status		
Owned	324	91.8
Rented	29	8.2
Total	353	100.0
House Value		
NA	30	8.6
Under 9,999	60	17.0
10,000-14,999	47	13.4
15,000-19,999	61	17.3
20,000-24,999	49	13.4
25,000-29,999	33	9.4
30,000-39,999	33	9.4
40,000-49,999	12	3.5
50,000-59,999	9	2.6
60,000 or more	19	5.4
Total	353	100.0

Table II-28 (Cont'd)

Characteristic	Number	Percent
Acres Owned		
Less than 99	95	26.9
100-299	54	15.3
300-499	36	10.2
500-999	35	9.9
1,000-1,499	10	2.8
1,500-1,999	3	0.9
2,000-2,999	4	1.1
3,000 or more	3	0.9
None	113	32.0
Total	353	100.0

Source: East Texas State University, 1971.

4. These data indicate that the respondents, on the whole, are people with a substantial personal and economic investment in their local communities.

(b) Patterns of involvement in local communities. The respondents were generally active members of their local communities. Many of the respondents held memberships and offices in several types of organizations. Almost 96 percent of all the respondents belonged to at least one local organization, the most frequent being the church. There were relatively more respondents active in civic and community organizations than in professional, government, and water-related organizations.

1. In regard to general attitudes toward the community, most of the respondents replied favorably. The data in table II-29 show that the majority (60.3 percent) felt that the people of their community reacted quickly when problems arose requiring action. Most of the respondents felt that their community was not a divided one and that it was well organized for continuing development (56.7 percent). The majority also agreed that the people did care about the community and that different groups and organizations with different interests worked well together on most projects.

2. A majority of the respondents were in agreement that the community should use Federal or state funds in its development programs, and that it should be ready to make some adjustments in order to get Federal or state help for projects. Twenty-five percent of the respondents indicated that the community should make full use of Federal or state funds no matter what strings might be attached. This shows that these respondents were almost desperately inclined to use government funds in whatever form these would be available, and almost reflects a feeling of inadequacy for local resources as far as the pursuing of the developmental programs was concerned.

(c) Patterns of involvement in soil conservation and in other watershed programs. Over 90 percent of the respondents felt that water resources management is a serious responsibility and should be executed carefully since water is basic to the local economy (table II-29). Only about 25 percent believe that water is actually more of a problem or threat than a resource. Thirty percent of the respondents were members of the Soil Conservation District of which 97 percent had previously assumed leadership roles in the development of watershed projects in their area.

(3) Sociological analysis of residents of the project area below the proposed damsite

(a) General. The respondents of this study were selected from residents of the area considered to be significantly affected by the channeling of the Sulphur River proposed in the authorized plan (draft EIS plan). This area extended from the Franklin--Hopkins and Lamar--Red River County lines on the west to US Highway 259 on the east. The area extended 10 miles both toward south and north of the Sulphur River. It included portions of Bowie, Red River, Franklin, Morris, and Titus Counties. A 50-percent sample of the 1,116 heads of households in the area was selected through systematic random sampling technique. A 2-page questionnaire was prepared that covered questions dealing with personal information of the respondents and their involvement patterns in the Cooper Lake and Sulphur River Channeling projects. The questionnaire was personally handed to the selected residents who were asked to return it by mail in a self-addressed and stamped envelope. Three followup reminders were sent to the questionnaire recipients within a period of 2 months. At the end of this period it was found that 259 questionnaires had been returned, representing 23.2 percent of the total number of households in the area.

Table II-29

Selected Attitudes of Respondents by Percentages

Item	Agree (Percent)	Disagree (Percent)	No Response (Percent)	Total (Percent)	Total (Number)
Attitudes Toward Community					
The people of the community are usually quick to respond when problems arise requiring action.	60.3	15.3	24.4	100.0	(353)
This community is like a house divided against itself.	11.0	64.9	24.1	100.0	(353)
This community is well organized for continuing development.	56.7	19.0	24.3	100.0	(353)
People here don't care enough about this community to do anything about it.	11.0	64.3	24.7	100.0	(353)
Groups and organizations with different interests work together in this community rather than fighting among themselves.	67.4	8.5	24.1	100.0	(353)
Use of External Funds					
This community should completely avoid using Federal and state funds in its development programs.	5.9	68.3	25.8	100.0	(353)
This community should use Federal or state assistance only when there are no strings attached.	21.2	52.7	26.1	100.0	(353)

Table II-29 (Cont'd)

Item	Agree (Percent)	Disagree (Percent)	No Response (Percent)	Total (Percent)	Total (Number)
This community should be ready to make some adjustments in order to get Federal or state help for projects.	64.9	9.9	25.2	100.0	(353)
This community should make full use of Federal or state funds no matter what strings might be attached.	24.9	49.6	25.5	100.0	(353)
<u>Attitudes Toward Water Resources Planning</u>					
How the water resources are managed will be one of the keys to the overall future of this area.	97.7	1.4	0.9	100.0	(353)
We need not be concerned about water: The laws of nature will take care of it for us.	2.8	96.9	0.3	100.0	(353)
Man has a real responsibility to manage his water resources as carefully as possible.	98.9	0.8	0.3	100.0	(353)
While we must have it to survive, water is actually more of a problem or threat than a resource.	26.1	75.5	1.4	100.0	(353)
Water is basic to our local economy.	96.3	2.8	0.9	100.0	(353)
Water management is seldom as important as it is said to be by people and groups who are trying to promote it.	7.7	90.9	1.4	100.0	(353)

Source: East Texas State University, 1971.

(b) Demographic characteristics

1. Examination of the frequencies in table II-30 reveals a profile of respondents as older (nearly 25 percent were 70 years old or older) and residentially stable rural residents. They were predominately males and a majority of them had lived in the present community all their lives; however, the balance, over 40 percent, were not native born residents of the area.

2. It may be observed from the table that about 40 percent of the respondents were engaged in nonfarm occupations. Only 21 percent were engaged in some type of farming. The predominance of upper-age groups among respondents might account for the quite high ratio (37.1 percent) of retired or unemployed persons.

3. The respondents were predominantly landowners; however, most of them had relatively small land holdings. The data in table II-30 show that 47.9 percent of them owned less than 99 acres, while only 6.5 percent owned more than 500 acres of land.

4. Slightly less than one-half of the respondents had high school diplomas; however, nearly 10 percent held college degrees.

5. The remainder of the survey dealt with respondent attitudes to the Cooper Lake and Channels project. These involvement patterns and attitudes are discussed in the impact section (refer to paragraph 4.02a(2)(d)1 on page IV-15).

2.09 MISCELLANEOUS ELEMENTS

a. National forests and grasslands. Part of the Ouachita National Forest in southeast Oklahoma is within a 100-mile radius of Cooper Lake. This portion, located in McCurtain County, is a part of the Tiak Ranger District and contains 43,068 acres of forestland (personal communication, United States Forest Service, Ouachita National Forest Supervisors Office). The Caddo National Grassland, a public property totaling 17,729 acres, is located in Fannin County, within a 50-mile radius of Cooper Lake. The Caddo Grassland is an administrative unit of the Panhandle National Grasslands of the US Department of Agriculture's Forest Service. These grasslands contain three lakes (Davy Crockett, Coffee Mill, and Fannin) with a total of 1,247 surface acres. These lands are managed by the Forest Service for the perpetuation of five major

Table II-30

Selected Demographic and Socioeconomic Characteristics of the Respondents

Characteristics	Number	Percent
Years Lived in Community		
All My Life	143	55.2
Migrant	115	44.4
No Response	1	0.4
Total	259	100.0
Age (Years)		
Birth - 29	20	7.8
30-34	9	3.5
35-39	21	8.1
40-44	17	6.7
45-49	29	11.2
50-54	22	8.2
55-59	26	10.0
60-64	28	10.8
65-69	25	9.7
70 or more	62	24.0
Total	259	100.0
Sex		
Male	211	81.5
Female	48	18.5
Total	259	100.0
Occupation		
Farm Only	36	13.9
Nonfarm Only	106	40.9
Farm and Nonfarm	19	7.3
Retired or No Work	96	37.1
No Response	2	0.8
Total	259	100.0
Years of Education		
16 or more	14	5.4
16	10	3.9
13-15	19	7.3
12	70	27.0
9-11	60	23.1
1-8	81	31.3
No School	2	0.8
No Response	3	1.2
Total	259	100.0

Table II-30 (Cont'd)

Characteristics	Number	Percent
Acres Owned		
Less than 99	123	47.9
100-299	31	12.0
300-499	8	3.1
500-999	11	4.2
1,000-1,499	4	1.5
1,500-1,999	0	0
2,000-2,999	1	0.4
3,000-or more	1	0.4
None	78	30.1
No Response	2	0.8
Total	259	100.0

Source: East Texas State University, 1972.

resources - wood, forage, wildlife, water, and recreation - with forage being considered the most important. The Caddo Grassland is divided into three major units: (1) a portion of the Caddo Grassland is located between Ladonia and Wolfe City, Texas, along both sides of Highway 34; (2) a second portion of the Caddo Grassland is located about 10 miles north of Honey Grove, Texas, mostly on the west side of Highway 100; and (3) the third portion of the Caddo Grassland is located adjacent to the Red River about 12 miles north of Bonham, Texas, on the east side of Highway 78.

b. State owned and/or managed wildlife lands

(1) Texas. The State of Texas operates one game management area and one refuge within a 50-mile radius of the project site and another game management area within a 50-100 mile radius of the project site. The first mentioned above is the Pat Mayse Wildlife Management Area, located on the upper end of Pat Mayse Reservoir, about 12 miles north of Paris, Texas. This tract, consisting of 8,317 acres of land and water, is leased from the US Army Corps of Engineers. Management objectives on this area include both public consumptive and nonconsumptive uses of wildlife. The refuge mentioned above is the Gambill Goose Refuge located about 7 miles northwest of Paris, Texas. This tract is leased from the city of Paris and consists of 674 acres, including the lake. In

addition to being a goose refuge, the area is managed for nonconsumptive use of wildlife and for fishing, which is allowed on the lake. The other management area operated by the State of Texas is the Gus Engeling Wildlife Management Area located about 18 miles northwest of Palestine, Texas, and about 86 miles directly south of the project site. This tract consists of 10,941 acres of state-owned land. Management objectives on Gus Engeling include research and demonstration, public hunts which are conducted during regular season, and public fishing on a small creek which drains the area.

(2) Adjacent states. There is one wildlife management area and two refuges in adjacent states, but within a 50-100 mile radius of the project site. The Sulphur River Wildlife Management Area in Miller County, Arkansas, contains approximately 16,000 acres and is located between US Highway 71 and State Highway 237 on the Sulphur River. The Pushmataha Wildlife Refuge comprises 18,260 acres and is located 4 miles south of Clayton, Oklahoma. The McCurtain County Game Refuge is adjacent to Broken Bow Reservoir, Oklahoma, and contains approximately 15,200 acres.

2.10 FUTURE ENVIRONMENTAL CONDITIONS OF PROJECT AREA WITHOUT THE PROPOSED PROJECT

a. The Sulphur River Basin is in an area that is largely agricultural with special emphasis placed on animal husbandry, consisting of beef and dairy cattle. Prior to intervention by the Corps of Engineers, the state, and local interests constructed levee systems which allowed flood protection for nearly 40,000 acres of land. With the commencement of the Cooper Lake and Channels project, local flood protection endeavors virtually ceased and many of the levees have fallen into various stages of neglect.

b. Without continuation of the prop d project, approximately 90,000 acres of the basin will continue to be periodically flooded. It is not, however, reasonable to assume that these status quo environmental conditions would be preserved since continued efforts by local interest to control flooding can be expected. Implementation of still highly controversial land use plans might be the only method of securing some environmental stability. Even with a minimum success in land reclamation, recreation benefits from the status quo are considered negligible since the majority of the area is not accessible to the public.

c. Water quality and quantity are seasonally erratic. This precludes the full development of recreational uses of the rivers and results in inadequate municipal water supplies for much

of the area. Efforts to provide adequate water supplies will be forced to continue on a "piece-meal" basis.

d. This lack of water supply and flood control will limit growth in population, businesses, and farms on a community and regional basis.

e. The alternating pattern of flooding and drought conditions is an historical aspect of the Upper South Sulphur River watershed. Land-use patterns on the watershed within the past century have undoubtedly accentuated the severity of these alternating aspects. As one result of unpredictable flow patterns in the Upper South Sulphur River drainage, carrying capacities on the bottom lands, including the riparian woods, are far below potential for many species of vertebrates. If the proposed project is terminated, these trends will probably continue. More predictable and uniform flow patterns on the other hand will likely enhance carrying capacities for several species of fish and terrestrial vertebrates.

2.11 INTERRELATIONSHIP OF PROJECT AND ALTERNATIVES PROPOSED, UNDER CONSTRUCTION, OR IN OPERATION BY ANY AGENCY OR ORGANIZATION

a. Federal projects

(1) Wright Patman Dam and Lake. The Wright Patman Dam and Lake (Lake Texarkana), Texas, project (designated Wright Patman Dam and Lake by Public Law 93-186) was authorized by the Flood Control Act of 24 July 1946 as part of a comprehensive plan for flood control in the Red River Basin below Denison Dam. The project contains a storage capacity of 2,654,300 acre-feet, of which 145,300 acre-feet are for conservation storage and 2,509,000 acre-feet are for flood control storage. During periods of high water in this area, the project provides the means by which water can be released at a controlled rate, thereby reducing potential flooding caused by high water stages of the Red River. The operational plan for the lake also permits withdrawal of surplus water for municipal and industrial purposes by the cities of Texarkana, Arkansas, and Texarkana, Texas. The proposed plan will permit 120,000 acre-feet of flood control storage space in Wright Patman Lake to be reallocated for water supply. A water supply contract with the city of Texarkana, Texas, covering the storage, which could be converted if Cooper Lake is completed, was signed in April 1968 and approved by the Secretary of the Army on 11 July 1968.

(2) Channelization. Realinement of the natural channel between South Sulphur River mile 8.7 and Sulphur River mile 185.0 was completed in part at the initial construction of levees in the 1920's and in part by the Corps of Engineers in 1952 under Section 2 of the Flood Control Act of 1937. These channels are now being used to carry rainfall-runoff and no additional work will be required under the selected plan.

(3) Soil Conservation Service (SCS)

(a) As a result of a USDA Type 4 Survey, Public Law 566 (Watershed Projects) authorized for construction prior to 31 December 1962 two projects in the Sulphur River Basin. These two projects were not completed prior to 1962 but have been completed as of this date. These two projects are referred to as the Auds Creek and Langford Creek projects. The Auds Creek project is located in Lamar County (south of Paris) and consists of 13 flood control structures. The Langford Creek project is located in Red River County (near Clarksville) and consists of 10 flood control structures and one multipurpose structure which serves as a water supply for Clarksville as well as flood control. A third project was approved by the Soil Conservation Service for the Sulphur River Basin in July 1975. Construction is expected to begin in late 1977. This is the Deport Creek project (Lamar County) and will serve as a flood control measure for the city of Deport. The three projects are located downstream from the Cooper damsite and would not influence the watershed of Cooper Lake; however, they would be within the watershed of downstream levees. The Soil Conservation Service became concerned over the influence of these flood control structures on downstream water yield, even though none of them had a water storage capacity which exceeded 200 acre-feet. As a result of this concern, the Soil Conservation Service employed the Balcones Research Center of Austin to conduct tests to determine the influence of these flood control structures on downstream yield. The Balcones Research Center reported no decrease in downstream yield. The structures will regulate the rate at which water enters some areas.

(b) All of the drainage into the Sulphur River from the north lies in the Northeast Texas Resource, Conservation, and Development Project which was approved on 29 June 1975. This project contains proposals for the treatment of the critical areas in the project area. This would greatly reduce sedimentation in the reservoir as well as to downstream areas.

(c) Several "long-range" projects were recommended in the USDA Type 4 Survey. The Deport Creek project discussed above was included in this category. Each would have to

be evaluated on an individual basis as to their impact on the proposed Cooper project. Since these projects are recommendations of need and not implementation, sufficient data is not available at present to evaluate their impact on the Cooper project. The "long range" SCS plan includes five multiple-purpose watershed projects (within 10 years), one multipurpose watershed project (considered potentially feasible for long-range development after 10-15 years), and seven single-purpose projects (potentially feasible beyond 10-15 years).

(4) United States Army. Two Red River Arsenal Lakes were constructed for fishing. Elliott Lake (approximately 250 acres) allows public usage; whereas, Caney Lake (also 250 acres) permits fishing by only arsenal employees. These two projects will not influence the Cooper Lake project, but they do influence, to a very minor degree, the runoff into Wright Patman Lake.

b. State projects. The Texas Water Development Board has authorized the 39 water projects listed in table II-31 in the 11 counties associated with the Sulphur River Basin. Sixteen of these have been approved since the original inventory and survey of the basin by East Texas State University in 1971. Only two of these projects would have an impact on the selected plan, namely, the White Oak Bayou and the Wright Patman Lake projects. In 1971 the city of Sulphur Springs, Texas, (Hopkins County) constructed a new lake on White Oak Bayou and increased the water holding capacity by 14,160 acre-feet, as compared to the city's old lake, Century, located on the same stream. This will influence the amount of water entering the Sulphur River above the Wright Patman damsite. Wright Patman Lake will influence the Cooper Lake project, as mentioned in paragraph 1.03a(1), and paragraph 1.06 but the contractual agreement in 1968 to increase the water supply capacity of Wright Patman Lake by 120,000 acre-feet is dependent upon the successful completion of Cooper Lake.

c. Private and municipal projects

(1) Fishing lakes. The following lakes are natural or man-made fishing lakes in the basin (Bonn and Inman, 1955):

Name	Location	Type	Acres
Baker Slough	Cass County	Natural Oxbow	50
Thomas Lake	Cass County	Natural Oxbow	60
Big Lake	Bowie County	Natural Oxbow	30
Mauldin Lake	Bowie County	Natural Oxbow	40
Grass Club Lake	Morris County	Artificial Private	40
Moore's Lake	Morris County	Artificial Private	17
White's Lake	Titus County	Natural Oxbow	3
Oliver Lake	Titus County	Natural Oxbow	25
Beaver Hole Lake	Titus County	Natural Oxbow	1
Coleman Lake	Hopkins County	Artificial Public	33
Century Lake	Hopkins County	Artificial Public	555
White Oak Bayou	Hopkins County	Artificial Public	541
Gordon Club Lake	Lamar County	Artificial Private	76
Wolfe City Lake	Hunt County	Artificial Public	35

(2) Flood control. Prior to construction efforts by the Corps of Engineers, local interests had completed levee work along about 8 miles of the Middle Sulphur and South Sulphur Rivers upstream from the proposed Cooper Lake and had completed levees and channel realinement along about 31 miles of the South Sulphur, North Sulphur, and Sulphur Rivers downstream from the proposed Cooper Lake to protect approximately 3,000 and 36,000 acres, respectively, of agricultural and pasturelands.

Table II-31

Texas Water Development Board Approved Projects in the Sulphur River Basin

County	Claimant, etc.	Type (Code)*	Purpose of Water Use	Amount of Water Acre-Feet/Year	Date of Permit	Maximum Rate of Diversion CFB	Stream From Which Water Diverted	Reservoir Capacity Acre-Feet
Bowie	International Paper Company	9	Industrial	120,000	8/5/68	62.0	Sulphur River	
	Wake Village	9	Municipal	359	11/28/69		Sulphur River	
	Hooks	9	Municipal	500	11/28/69		Sulphur River	
	Dekalb	9	Municipal	471	11/28/69		Sulphur River	
	New Boston	9	Municipal	785	11/28/69		Sulphur River	
	Maud	9	Municipal	247	11/28/69		Sulphur River	
	Avery	9	Municipal	92	11/28/69		Sulphur River	
Red River	Annona	9	Municipal	68	11/10/69		Sulphur River	
Bowie	New Boston	1	Municipal	325	9/10/45		Holly Creek	8
	Wright Patman	1	Municipal	45,000	4/18/51	455.0	Sulphur River	386,900
	W. E. Caldwell	5	Domestic		7/28/75		Rice Creek	
	N. L. Frame	2	Domestic		5/19/71		Akin Creek	
	C. C. Brewer	2	Domestic		7/22/71		Unnamed Creek	
	C. C. Brewer	2	Domestic		7/22/71		Unnamed Creek	
	C. C. Brewer	2	Domestic		7/22/71		Unnamed Creek	
	C. C. Brewer	2	Domestic		7/22/71		Unnamed Creek	
	J. Harvey	2	Domestic		7/22/71		Unnamed Creek	1
	W. E. Gibson	2	Domestic		8/19/71		Unnamed Creek	1
Cass	Rainey Est.	2	Domestic		6/15/70		Unnamed Creek	
	Anna Brabham	2	Domestic		5/21/71		Unnamed Creek	
	Roy Frost & Son	2	Domestic		5/25/71		Unnamed Creek	
	Hugh Frost & Son	2	Domestic		5/25/71		Unnamed Creek	
	David Frost	2	Domestic		5/25/71		Unnamed Creek	
	Carl I. Frost	2	Domestic		5/25/71		Unnamed Creek	

(Continued on next page)

Table II-31 (Cont'd)

County	Claimant, etc.	Type (Code)*	Purpose of Water Use	Amount of Water Acre-Feet/Year	Date of Permit	Maximum Rate of Diversion CFB	Stream From Which Water Diverted	Reservoir Capacity Acre-Feet
Fannin	Pecan Gap	2	Municipal		5/20/69	2	South Drainage	45
Hopkins	Sulphur Springs	1	Municipal	2,000	12/27/57		White Oak	2,206
	Sulphur River M.W.D.	1	Municipal	26,960	4/2/68		South Sulphur	81,470
	North Texas M.W.D.	1	Municipal	54,000	4/2/68		South Sulphur	114,265
	Irving (city)	1	Municipal	44,820	4/2/68		South Sulphur	114,265
	Sulphur Springs W.D.	1	Municipal	7,800	1/30/69	10.0	White Oak	14,160
	S. J. Matthews GST	2	Domestic		6/29/71		Richard Creek	
Hunt	Wolfe City	2	Municipal		9/9/68	0.6	Turkey Creek	
	Wolfe City	(w)4	Municipal		8/5/57		East Fork Turkey	
	Wolfe City	1	Municipal	300	10/30/57		Turkey Creek	855
Morris	Tommie Beggs	2	Domestic		6/11/70		White Oak	
Red River	Annona (city)	1	Municipal	255	12/20/29**			276
Titus	Consolidated Water Company	1	Domestic	210	7/14/36		Sulphur	104
	Consolidated Water Company	1	Domestic	150	7/14/36		Sulphur	54
	Mrs. W. H. Thompson	2	Domestic		9/2/71		Unnamed Creek	42

*1. Application
2. Claim
3. Certified Filing
4. (W) withdrawn or (R) refused
5. Withdrawn claim
6. Adjudication certified
7. 8. 9. Contractural permit
**Ammended 5/10/73

SECTION 3--RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS

3.01 CONFORMITY OF PROPOSED PROJECTS TO EXISTING OR PROPOSED FEDERAL, STATE, AND LOCAL LAND USE PLANS

a. Federal. Recent Federal land use legislation gives states two options: either to "follow Federal guidelines and develop a plan for the state's growth" or to "forfeit the power of local planning and decision to a new Federal agency, the Environmental Protection Agency (EPA)" (Wright, 1974). Texas has not complied with Federal water and air requirements; whereas, EPA does have air and water pollution plans for Texas. Although neither of these plans refer directly to land use, a court decision has declared that EPA could not allow clean air to be depreciated by new development. "Acting under that decision, the EPA will probably determine which areas of the state will be allowed to grow and which areas will not" (Wright, 1974). Some areas will be restricted to rural or low density residential use, similar to zoning for these purposes.

b. State. Although state agencies now communicate, there is no requirement that they adhere to coordinating planning and policies (Wright, 1974). Texas has considered several land use bills, but has not been responsive to Federal programs. "Texas counties cannot zone unincorporated lands, and acreage outside of existing cities is virtually unregulated as to use" (Wright, 1974). If legislation under consideration is passed, Texas eventually will be engaged in a statewide program of land use planning.

c. Regional and local

(1) Mr. Doug Collins, Director of Regional Planning, Ark-Tex Council of Governments (COG), in a letter dated 3 June 1974, indicated that his organization has no projected land use information for the area around the proposed Cooper Lake site. However, a division of the Council of Governments is working on a water quality management study for the Sulphur River Basin. This study should be complete in the near future, and it will include projected land use information for the Cooper Lake area.

(a) The Ark-Tex Council of Governments (1971) has prepared an interim land use plan for Bowie, Cass, Morris, and Red

River Counties in Texas and Miller County, Arkansas. The COG findings indicated that most communities are deficient in park and recreation land, and it recommended increasing land in this category. Their proposals for land use distribution in municipalities also involved increases in commercial and industrial acreages and reductions in residential and rights-of-way acreages. The COG recognized that "proposed new reservoirs and the need for developed land to accommodate a growing population would significantly decrease the amount of open land in the region for agricultural, scenic, recreational, and other such uses. The need for protection and preservation of this land would be especially critical at the edges of urban areas, the shoreline areas of lakes and alongside major highways" (Ark-Tex Council of Governments, 1971).

(b) A regional comprehensive open space plan for the Sulphur River Basin was formulated by the Ark-Tex Council of Governments (1972). The plan proposed that most of the Cooper Lake project area be left in either a natural or undeveloped state. A hiking and riding trail system should be part of a central regional trail system stretching from the site of Cooper Lake, along the Sulphur River, to its confluence with the Red River. The Council did suggest, however, that in certain areas, agricultural activities were not necessarily detrimental to the proposed open space preservation. It also recommended that implementation of this plan be closely coordinated with the Soil Conservation Service, the Corps of Engineers, and other interested agencies.

(2) Representatives of the Soil Conservation Service indicated that they have no existing or proposed land-use plans which would be affected by completion of the Cooper project (letters from Mr. Edward E. Thomas, State Conservationist, Soil Conservation Service, dated 11 June 1974, and from Mr. Marion S. Porter, Area Conservationist, Soil Conservation Service, dated 9 August 1974). Some small acreages of land owned by the State of Texas and administered by the General Land Office are located below the Cooper Lake reservoir site in Franklin and Red River Counties. Mr. Mike McKann, Resource Planner with the General Land Office, advised during a telephone conversation on 19 November 1975 that this land was currently in agricultural use and that no specific land-use plans have been developed for the land in this area by the General Land Office; however, the situation with respect to land use will be reviewed in 1976. In a telephone conversation on 8 March 1977, Mr. McKann indicated that he anticipated no land-use conflicts since most of the General Land Office holdings in the Sulphur River Basin were being leased for grazing. The New Orleans District will keep Mr. McKann informed of Corps activities throughout the planning process.

(3) The executive directors of the Agricultural Stabilization and Conservation offices in each of the affected counties were contacted by letter concerning the impact of the proposed project. None of the respondents indicated that the project would adversely affect any existing uses of the land or any plans for future utilization of the area. A list of the respondents follows:

(a) Cargile, Peggy C., Franklin County ASCS. Comments to US Corps of Engineers, received 10 June 1974.

(b) Harrison, Everett D., Jr., Hunt County ASCS. Letter to Corps of Engineers, dated 10 June 1974.

(c) Jarvis, Robert E., Hopkins County ASCS. Letter to US Corps of Engineers, dated 13 June 1974.

(d) Johnson, Dora H., Delta County ASCS. Letter to US Corps of Engineers, dated 17 June 1974.

(e) Jones, Harmon W., Bowie County ASCS. Letter to US Corps of Engineers, dated 7 June 1974.

(f) Murphy, Lane, Red River County ASCS. Letter to US Corps of Engineers, dated 14 June 1974.

(g) Wilson, Givens C., Cass County ASCS. Letter to US Corps of Engineers, dated 10 June 1974.

SECTION 4--THE PROBABLE IMPACTS OF THE PROPOSED ACTION ON THE ENVIRONMENT

4.01 NATURE OF IMPACTS

a. Construction. The selected plan consists of the construction of a multipurpose reservoir and levees to provide flood protection in the Sulphur River Basin above Wright Patman Lake. This plan would cause the loss of 16,370 acres of bottomland hardwoods and 19,875 acres of semiwooded and cleared lands, either directly to project features, or indirectly by induced clearing due to flood protection provided to landowners. These losses would adversely impact upon the ability of these areas to support consumptive and nonconsumptive recreation. Impoundment would result in a drastic increase in potential for flat water fishing, both sport and commercial, while providing a much needed water supply for area users. At the same time, inundation of the reservoir area will force the relocation of several roads, utilities, and graves, and will either destroy or cover with water and/or silt numerous archeological sites which have not been salvaged. Construction features will produce some minor air, noise, and water pollution; however, the area is sparsely settled and a minimum of adverse social impacts is expected.

b. Operation and maintenance. Operation and maintenance activity will be directed toward providing the authorized benefits of the project, preserving its useful life, and minimizing the impact of inherent damage due to construction, operating procedures, and/or public use pressure.

4.02 BENEFICIAL AND ADVERSE IMPACTS

a. Beneficial impacts

(1) Reservoir

(a) Hydrological impacts

1. Flood control and water supply. The reservoir provides 131,400 acre-feet of storage space for the control of runoff originating above the damsite. This will provide flood protection to 12,900 acres of land for floods having a recurrence interval of once every 30 years. The protected acreage is

located primarily along the South Sulphur River where flood discharges will be significantly lowered. The reservoir will have less effect on reducing floodflows as the drainage area increases below the damsite. The flood control storage will control flood runoff for floods up to and including the design flood to a maximum controlled release of 3,000 cubic feet per second (c.f.s.). This flood storage will also permit the conversion of 120,000 acre-feet of flood storage in Wright Patman Lake to water supply. An additional 273,000 acre-feet of storage space for municipal and industrial water supply will be provided in Cooper Lake. This space will supply an estimated water supply yield of 164 c.f.s. (105.8 million gallons per day) plus a minimum low flow release of 5 c.f.s. (3.2 m.g.d.) in the downstream channel, whereas the stream has had zero (o) flow at times.

2. Surface and ground water. The creation of the lake at water supply pool elevation 440.0 feet m.s.l. will inundate 19,305 acres of land. The use of the reservoir for flood control will induce periodic inundation of additional acreage varying from 19,305 acres at elevation 440 feet m.s.l. to 22,740 acres at elevation 446.2 feet m.s.l., the top of flood control pool. In essence, then, about 3,435 acres will be intermittently flooded due to flood control requirements. In general, the soils surrounding the reservoir area are low in permeability, and the effects of pooling water behind the dam are expected to be minimal on surrounding ground water conditions.

3. Water quality. In the long term, water quality below the dam will be improved, primarily by removing sediment which would normally be carried to Wright Patman Lake. This may decrease the cost of water treatment for users of water from Wright Patman Lake.

(b) Biological impacts

1. Aquatic ecosystems

a. Tributaries and tailwaters

(1). Tributaries. The loss of natural channel on the South Sulphur River, due to inundation by the reservoir, will be partially compensated for by positive effects of the reservoir on major tributaries immediately above the reservoir. Game fish species such as white bass migrate miles upstream during the spawning season and normally provide very good seasonal fishing. Other species such as white crappie also migrate a lesser distance upstream and provide good fishing during late

winter and spring. Small intermittent streams or normally dry creeks and gullies immediately around the reservoir and upstream will be influenced very little by the lake. Any influence on these small tributaries will be that of providing occasional fish stock replenishment in whatever permanent water exists in the stream beds.

(2). Tailwaters. The tailwater areas of the reservoir often contain large and diverse fish populations when compared to impounded waters. The physical barrier provided by the dam and environments tolerant to both lake and stream species account for high fish concentration particularly in spring or when water is being released from the reservoir. These areas are often the site of the most intense fishing pressure associated with the reservoir, with the catch rate being much higher than on the reservoir when fish are concentrated. Streams below the reservoir will show little influx of lake species because of rather intermittent flows. The release of water from the reservoir may augment natural low flows. However, these flows will not enhance downstream water conditions for fish populations in the long term since during dry periods when water flow is most needed, the discharge from the reservoir will be minimal. Normal releases from Cooper Lake will vary from a minimum of 5 c.f.s. to a maximum of 3,000 c.f.s. These releases will be gradually stepped from one extreme to the other to prevent rapid rates of rise and fall in tailwater elevations and to prevent adverse effects, such as stranding, on fish populations in the tailrace.

b. Lake

(1). Thermal stratification. Due to the size and depth of the reservoir, thermal stratification is expected to occur during summer. Fall turnover will redistribute the gases and nutrients and, unless excessive, will beneficially affect the fish food chain. The fall turnover is the most significant in redistribution of nutrients previously isolated in the non-photosynthetic hypolimnion. However, during spring and early summer, lakes stratify and mix at short intervals, maintaining adequate distribution of nutrients during the spawning and early growing season.

(2). Turbidity. The higher turbidity of inflowing waters above the reservoir will be reduced in the lake because of a decrease in the longitudinal velocities of the water. Plankton production and standing crop can be expected to increase with a corresponding reduction in current velocity and turbidity in the reservoir.

(3). Standing crop. Although a reduction in the diversity of fish fauna is expected, about 25 percent of the species occurring in the natural streams are expected to increase in numbers. These include some of the most desirable sport fish species such as crappie, bass, and catfish, and some of the commercial fish species including buffalo, carp, and drum. The reservoir will also provide habitat for introduced (stocked) species such as white bass, pike, and striped bass. In general, the standing crop of fish should be greatly increased.

2. Land systems

a. Timber resources. Of the 30,000 acres of right-of-way (R.O.W.) needed for the reservoir, 9,200 acres are in bottomland hardwoods. Although much of this timber will be lost in construction of the reservoir, 2,950 acres of bottomland hardwoods purchased as R.O.W. will remain unaffected and will be open for public access.

b. Agricultural lands. Of the total R.O.W., 20,800 acres are in semiwooded or cleared areas. Semiwooded areas are considered agricultural since, for the most part, they have been cleared of brush and small understory trees and are now grazed by cattle. Cleared lands have been converted to improved pasture and to a lesser extent may support agronomic crops. Of the total R.O.W. in these categories, 6,625 acres will not be directly affected by reservoir construction. Some of this area will be used for general recreational developments and, thus, will remain unforested; however, much of this area can be expected to succeed to a forested state.

3. Terrestrial ecosystems

a. Flora. Although the natural flora on about two-thirds of the reservoir R.O.W. will be inundated or in some other way adversely affected, the existing vegetation on 6,625 acres of semiwooded and cleared lands and 2,950 acres of bottomland hardwoods will not be adversely affected. Purchase of this area insures that the status quo on these 9,575 acres will not be further deteriorated by agricultural encroachment into the floodplain. The semiwooded areas contain essentially the same tree species, e.g. oaks, elms, hickories, and black willow, as the bottomland hardwoods, only in a lower density, with the understory vegetation cleared. These areas, for the most part, support native grasses which are heavily grazed by cattle. Under Federal ownership these lands should begin developing dense understories, and succession should eventually lead to reforestation of most of the area.

b. Fauna

(1). Invertebrates. On the 9,575 acres of R.O.W. that will not be adversely influenced by reservoir construction, invertebrate populations are expected to flourish. Without further stresses from pesticides, which may now be an important limiting factor to many organisms in this highly agricultural area, many invertebrate groups will likely abound.

(2). Amphibians and reptiles. The amphibians are confined to moist or aquatic habitats during at least part of their life cycle. All species that occur in the project area are expected to continue existence in that area. After impoundment, these species will generally be confined to the periphery of the lake and tributaries. This habitat will be more dependable than the now intermittent and sometimes dry stream beds. Certain species, including the central newt, western chorus frog, bullfrog, and bronze frog are expected to increase in numbers because the reservoir shoreline and the increase in shallow still water will improve their habitat. Two terrestrial turtles, the ornate and common box turtles, should remain common on upland areas around the lake. Of the 27 species of snakes that occur in the reservoir area, the western cottonmouth, mud snake, and plain-bellied water snake are primarily aquatic and are expected to increase in number after impoundment. All others should remain common in the area around the lake.

(3). Birds. The waterfowl, grebes, coots, terns, gulls, and shorebirds are expected to benefit from construction of the reservoir. Cooper Lake lies in the southern portion of the Central Flyway which is recognized as an important wintering area for waterfowl (Bellrose, 1976). The deeper areas of the lake will be especially compatible with the feeding habits of the "diving ducks." The fluctuating nature of the lake can have very positive food producing potential for all ducks, particularly the "puddle ducks." If, as expected, low levels in the lake occur during the summer, a variety of seed producing annual grasses may invade the moist shoreline. When water levels increase in the fall and winter, these seeds become an available food source for waterfowl. The diverse habitat that will remain around the perimeter of the reservoir should support an abundant population of nongame birds.

(4). Mammals. Although inundation of the reservoir area will, in general, displace most terrestrial mammals, the adjacent 9,575 acres of R.O.W. which will be unaffected by construction of the reservoir should support a good

population of most of the 42 species of mammals in the area. The edge effect provided by the lake may actually result in an increase in such species as the raccoon, opossum, nutria, and swamp rabbit.

4. Endangered and threatened species

a. Flora. Based on the Federal Register (16 June 1976) list of endangered or threatened plants, none of the plant species listed in the inventory of the Sulphur River Basin by East Texas State University (1971), appendix B, are considered to be endangered or threatened. The project will not adversely affect any known critical habitat for threatened or endangered species.

b. Fauna. Three species of birds (southern bald eagle, peregrine falcon, and whooping crane) and one species of reptile (the American alligator) that were listed in the East Texas State University (1971) Inventory of the Basin are included in the US Department of the Interior (1974), "United States List of Endangered Fauna." The wintering habitat of the southern bald eagle will be improved by the project, but it is recognized that this is not the limiting factor for this species. The peregrine falcon and the whooping crane are not expected to be significantly influenced by the project. The American alligator's status in the basin is unknown; therefore, the exact impact that the reservoir will have on this reptile is uncertain. It is likely that the increased water area will enhance available habitat, which will permit a restocking program if deemed feasible. This project feature will not adversely affect any known critical habitat for threatened or endangered species.

5. Vector populations. Dr. E. Fred Klaus, a contributor to the Environmental Inventory and Survey of the Sulphur River Basin prepared by East Texas State University in 1971, indicated that the reservoir should be of real benefit in reducing mosquito populations (telephone conversation on 26 August 1976). He said that source reduction by impoundment is recommended in habitat of the type found in the project area. Following project completion, mosquito breeding and development sites should be confined primarily to the shallow waters near the banks of the reservoirs. Similarly, Mr. Bobby Davis, entomologist with the Vector Control Division of the Texas State Department of Health, indicated that a good method for controlling mosquito densities in the project area would be through impoundment (telephone conversation on 26 August 1976). He further stated that the proposed reservoir clearing should significantly reduce vector populations below existing levels.

(c) Recreational impacts

1. General. Participation in local outdoor recreation activities by Sulphur River Basin residents has been quite limited in the past, due primarily to the lack of suitable areas and facilities. The reservoir and recreation facilities would provide the needed resources and development for many types of local outdoor recreation.

2. Recreation potential of the project. The 19,305-acre water supply pool and surrounding lands will have the capacity to accommodate 9,726,000 water-oriented activity occasions annually. Based on population projections, the maximum recreational demand upon this project would be 2,196,000 recreation days per annum by the end of 50 years.

3. Development of recreation and wildlife areas. Seven sites totaling 3,300 acres of land are designated as recreation and wildlife areas. Facilities, including ramps, trails, picnicking and camping areas, water supplies, comfort stations, shelters, beaches, and the necessary tour guides and safety features would be provided. The area required for the public use recreation areas would be included within the fee title taking line (the area to be purchased for construction of the reservoir) established for the reservoir.

4. Outdoor recreation attendance. The initial and projected general outdoor recreation visitation to Cooper Lake, was calculated using the procedures specified in Engineering Regulation 1120-2-403, "Estimating Initial Reservoir Recreation Use," prepared by the US Army Engineer District, Sacramento, California, for the Office of the Chief of Engineers, Department of the Army (1969). The methodology utilized in these calculations was presented in the draft EIS dated 10 June 1976. It was determined that the initial general recreation use at Cooper Lake would be 1,558,000 annually. Inasmuch as these benefits had not been approved at the time of this writing, this final document has been revised to reflect the currently approved recreation figure of an initial use by 741,000 visitors, annually. Application of a general recreation day value of $1.50 results in an annual benefit of $1,111,500.

5. Fish and wildlife resources. Fish and wildlife resource benefits, based on an average water supply pool of 17,400 surface acres, were computed for the reservoir (table IV-2). These benefits include a total of 178,315 man-days of consumptive recreation which have an annual value (benefit) of approximately $286,900. In addition, the reservoir is capable of supporting an annual harvest of 417,600 pounds of commercial fish valued at $48,720.

Table IV-2

Wildlife and Fishery Benefits from the Reservoir[1]

Category	Gains	Value
Sport Fishing	174,000 man-days[2]	$261,000[3]
Commercial Food Fish	139,200 pounds[4]	$34,800[5]
Commercial Nonfood Fish	278,400 pounds[6]	$13,920[7]
Waterfowl Hunting	4,315 man-days[8]	$25,890[9]

[1]All figures are based on an average water supply pool of 17,400 acres.

[2]10 man-days/acre - potential sport fishing.

[3]$1.50/man-day - value of sport fishing.

[4]8 lbs/acre - potential harvest of commercial food fish.

[5]$0.25/lb - average commercial food fish value.

[6]16 lbs/acre - potential harvest of commercial non-food fish.

[7]$0.05/lb - average commercial nonfood fish value.

[8]0.248 man-day/acre - potential waterfowl hunting.

[9]$6.00/man-day - value of waterfowl hunting.

(d) Socioeconomic impacts

1. Sociological analysis

a. General. Local support is important in the development of public works projects. If public investment is to produce optimum economic and social benefits, the residents of local communities must be cognizant of the project and alert to the opportunities for economic and social growth.

b. Local attitudes. In 1971, representatives of East Texas State University developed a research project to evaluate the degree to which the reservoir project was supported and to determine what economic and social impacts were anticipated by local citizens on their communities. This study measured responses from two subsets of people within the region, namely (1) community leaders and (2) residents located within the reservoir impact area.

(1). Attitudes on regional water resource projects. Over two-thirds of the respondents in this study indicated that the communities should utilize public funds

for the development of natural water resources of the region. And, if necessary the residents should be willing to make adjustments to secure Federal and state support for the projects. Almost 100 percent of the residents interviewed indicated that they supported the development of the region's water resources. Further, they felt that adequate supplies of water were the key to local economic development.

(2). Attitudes on the Cooper Lake project. In excess of 80 percent of the respondents were of the general opinion that everyone in the area would benefit from the project. Nearly three-fourths of those interviewed felt that the project would create no adverse environmental problems and nearly 90 percent felt that economic and other benefits of the project were greater than its environmental consequences.

2. Economic impacts. Substantial beneficial impacts to man-made resources are expected through the provision of adequate water supply and recreational resources, including access roads. Some 13,000 acres will be protected from overflow. The provision of water supplies and the limited relief from flooding would enhance community cohesion to a moderate degree. The favorable impacts to employment and income would be moderate during construction and minor, subsequently, as otherwise underemployed labor would be utilized in construction, operation and maintenance, and in induced recreation-oriented employment. Property values and tax revenues will be moderately benefited. There will be no displacement of people or businesses. Agricultural lands will be taken for the reservoir site; however, flood protected lands will allow for the development of other agricultural sites. Most of the cleared land being utilized by the project is not under intensive agricultural use. Therefore, the impact on total agricultural productivity of the region will not be great under the current structure of input costs and product prices. However, a new opportunity will exist for rather intensive use of the Sulphur River Flood Plain below the reservoir. The total agricultural productivity of the area should be enhanced as a result of projected development. Some community and regional growth is expected. Moderate beneficial impacts will arise in nearby urban areas through the provision of an adequate, dependable water supply. This water supply will provide substantial improvement in the local ability to prepare for a sustained drought.

(2) Levees and channels

(a) Hydrological impacts. The levees and channels feature of the selected plan will provide flood protection for

11,400 acres of land along the South Sulphur and Sulphur Rivers, for floods having a recurrence interval of once every 30 years.

(b) Biological impacts

1. Aquatic ecosystems. Construction of the limited realined channel will create 5 miles of oxbow cutoffs along the South Sulphur River and 11 miles of cutoffs along the Sulphur River (table IV-3). This will result in a total of 96 surface acres of oxbows. Areas of this type are known for their high degree of sport fishery potential. The productivity of oxbows often exceeds that of larger nonoverflow lakes and streams. Although overbank flooding is generally considered essential to the maintenance of a productive oxbow fishery, reduction of overbank flooding will decrease the rate of siltation of the oxbows, and should result in extending the life of these areas. In addition, reduction in overflow should minimize the chance for contamination from agricultural chemicals carried in the river. However, these isolated bodies of water, particularly near agricultural croplands, are benefitted by the "flushing" effect of periodic overflow, which reduces the accumulation of agricultural chemicals in runoff from adjacent cleared land. Reduced turbidity in these cutoff lakes (oxbows) will result in an increase in plankton. Establishment of the required levees involves borrow excavation, with subsequent formation of a limited number of riverside borrow ditches. These pits may benefit fishing in the area; but again, high production levels are closely correlated to periodic overflows.

2. Land systems. Approximately 800 acres (600 acres in bottomland hardwoods and 200 acres in semiwooded or cleared area) of land will be lost or modified by construction of the levees. Modified areas will either be in the form of levees or disposal areas for excavated material from the limited channel construction. All levee surfaces will be cleared, grubbed, and planted with Bermuda grass. They will be maintained in herbaceous vegetation and should provide some support habitat for rabbits, deer, quail, turkey. and numerous nongame species. Early stages of plant succession on disposal areas will create habitat favorable to rabbits, quail, dove, and deer. Nesting passerines will also benefit from these early successional stages of herbaceous and brushy vegetation. As natural succession continues, the herbaceous vegetation will be replaced by shrubs, trees, and vines, and the area may regain its former value to wildlife.

3. Terrestrial ecosystems

a. Flora. Although that area to be used for levee construction will be initially denuded, the levees

will be planted with Bermuda grass. It is also very likely that native herbaceous species will encroach; however, the levees are to be kept clear of trees and shrubs. Unless agricultural interests manage the disposal areas for grazing, succession to the shrub and tree stage can be expected during the project life.

b. Fauna

(1). Amphibians and reptiles. The relatively shallow, open water areas of the borrow pits and oxbows will improve conditions for such species as the central newt, western chorus frog, bullfrog, bronze frog, and most turtles. The ornate and common box turtles should remain common on the cleared and semiwooded areas. The primarily aquatic snakes are not expected to be affected significantly by construction of the levees, except for slight increases in and around oxbows and borrow pits. Snakes preferring dryer habitats can potentially increase on the newly constructed levees and disposal areas if cover requirements are adequate.

(2). Birds. The development of borrow areas and oxbow lakes will benefit to some degree the nesting and feeding habitat of waterfowl, especially the wood duck. Disposal areas will provide excellent feeding habitat for dove and quail during the early successional stages. With the existing potential for a wild turkey population east of Highway 271, the intermittent clearing for project construction may be beneficial. In essence, the losses in woodland acreage may be compensated for by an increase in edge.

(3). Mammals. Opossum and raccoon populations should increase in proportion to the amount of induced clearing and increase in agriculture, assuming that an adequate supply of mature den trees remain. The cottontail rabbits will benefit from the herbaceous vegetation on the levees, disposal areas, and improved pastures. The white-tailed deer, the only huntable big game species in the basin, will be benefitted somewhat by the interspersion of the herbaceous vegetation on the levees with the remaining bottomland hardwoods.

4. Endangered and threatened species

a. Flora. None of the plant species that may be adversely affected are considered to be endangered or threatened. The project will not adversely affect any known critical habitat for any threatened or endangered species.

b. Fauna. Although the true status of the American alligator in the affected area is unknown, some of the project features, e.g., the borrow pits and oxbows, will provide new habitat for the alligator, thus, promoting the potential for a restocking program. No other threatened or endangered species will be adversely affected nor will this project feature adversely affect any known critical habitat for any threatened or endangered species.

(c) Recreational impacts. Although the 96 acres of oxbows resulting from channel construction will provide only limited general recreation benefits, the potential fish and wildlife resource benefits are quite sizable (table IV-3). These benefits include a total of 3,192 man-days of consumptive recreation which have an annual value of approximately $5,000. In addition, the oxbows are capable of supporting an annual harvest of 3,360 pounds of commercial fish valued about $500.

(d) Socioeconomic impacts

1. Sociological analysis

a. General. In addition to the 1971 study of the attitudes of residents located within the reservoir impact area (previously referenced), a second research endeavor was conducted by the East Texas State University in 1972. The results are based on responses from a random sample of residents thought to be affected in some manner by the channel work proposed at that time (draft EIS plan).

b. Local attitudes. Analyses of data derived from the second study confirmed the results from the first research report that local residents were generally familiar with the total project and supported continued implementation of the project. Familiarity with the authorized plan was evident in that nearly 70 percent of those interviewed were acquainted with features of Cooper Lake and an even higher percentage, nearly 90, were aware of the Sulphur River channeling plan. Nearly 85 percent of those interviewed considered Cooper Lake and the Sulphur River channeling project to be among the best alternatives for water resource development in the region. One can conclude from the results of the two research studies that the draft EIS plan had strong local support.

2. Economic impacts. Man-made resources will be benefitted with the provision of flood protection for 11,400 acres of land. Enhancement of community cohesion will stem from the limited relief from flooding. Favorable impacts during

WILDLIFE AND FISHERY BENEFI

ALTERNATIVES	SOUTH SULPHUR RIVER OXBOW CUTOFFS MILES	ACRES [1]	SULPHUR RIVER OXBOW CUTOFFS MILES	ACRES [2]	TOTAL ACRES OF OXBOWS GAINED	MAN-DAYS OF SPORT FISHER GAINS FROM OXBOWS [3]
STATUS QUO	—	—	—	—	—	—
NONRESTRICTIVE EASEMENT	—	—	—	—	—	—
RESTRICTIVE EASEMENT	—	—	—	—	—	—
FEE PURCHASE	—	—	—	—	—	—
RESERVOIR ONLY	—	—	—	—	—	—
CHANNEL ONLY	5	10	35	273	283	9,339
LEVEES ONLY	5	10	11	86	96	3,168
RESERVOIR AND CHANNEL	5	10	35	273	283	9,339
RESERVOIR AND LEVEES (SELECTED PLAN)	5	10	11	86	96	3,168
CHANNEL AND LEVEES	5	10	44	343	353	11,649
AUTHORIZED PLAN (DRAFT EIS PLAN)	5	10	44	343	353	11,649
RESERVOIR, LEVEES, AND CHANNEL WITH LANDSIDE LEVEE BORROW	5	10	44	343	353	11,649
RESERVOIR AND LEVEE ALINEMENT WITH CHANNEL ADJACENT TO THE LEVEES	5	10	31	242	252	8,316
RESERVOIR AND CHANNEL ALINEMENT WITH LEVEES ADJACENT TO THE CHANNEL	5	10	44	343	353	11,649
RESERVOIR AND LEVEE ALINEMENT WITH CLEARING AND SNAGGING OF THE RIVER	5	10	11	86	96	3,168
RESERVOIR AND LEVEE ALINEMENT WITH CLEARING AND SNAGGING PLUS MAJOR BEND CUTOFFS	5	10	22	172	182	6,006
RESERVOIR AND LEVEE ALINEMENT WITH SELECTED MAJOR BEND CUTOFFS	5	10	22	172	182	6,006
RESERVOIR, LEVEES AND CHANNEL CHANNEL BOTTOM RAISED 5 FEET	5	10	44	343	353	11,649
RESERVOIR AND SELECTIVE FLOOD PROOFING BY RING LEVEES	—	—	17	133	133	4,389
RESERVOIR WITH ANIMAL REFUGE MOUNDS	—	—	—	—	—	—
RESERVOIR AND NONRESTRICTIVE EASEMENT	—	—	—	—	—	—
RESERVOIR AND RESTRICTIVE EASEMENT	—	—	—	—	—	—
RESERVOIR AND FEE PURCHASE	—	—	—	—	—	—

1. 2.0 ACRES/MILE OF FISHABLE WATER ON THE SOUTH SULPHUR RIVER
2. 7.8 ACRES/MILE OF FISHABLE WATER ON THE SULPHUR RIVER
3. 33 MAN-DAYS/ACRE - POTENTIAL SPORT FISHING
4. $1.50/MAN-DAY - VALUE OF SPORT FISHING
5. 35 L
6. $0.15
7. 0.248
8. $6.00

TAL ACRES F OXBOWS GAINED	MAN-DAYS OF SPORT FISHERY GAINS FROM OXBOWS [3]	SPORT FISHERY GAINS FROM OXBOWS [4] (DOLLARS)	POUNDS OF COMMERCIAL FISHES GAINED FROM OXBOWS [5]	COMMERCIAL FISHERY GAINS FROM OXBOWS [6] (DOLLARS)	MAN-DAYS OF WATERFOWL HUNTING GAINS FROM OXBOWS [7]	WATERFOWL HUNTING GAINS FROM OXBOWS [8] (DOLLARS)	TOTAL GAINS FROM OXBOWS (DOLLARS)
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
283	9,339	14,009	9,905	1,486	70	420	15,915
96	3,168	4,752	3,360	504	24	144	5,400
283	9,339	14,009	9,905	1,486	70	420	15,915
96	3,168	4,752	3,360	504	24	144	5,400
353	11,649	17,474	12,355	1,853	88	528	19,855
353	11,649	17,474	12,355	1,853	88	528	19,855
353	11,649	17,474	12,355	1,853	88	528	19,855
252	8,316	12,474	8,820	1,323	62	372	14,169
353	11,649	17,474	12,355	1,853	88	528	19,855
96	3,168	4,752	3,360	504	24	144	5,400
182	6,006	9,009	6,370	956	45	270	10,235
182	6,006	9,009	6,370	956	45	270	10,235
353	11,649	17,474	12,355	1,853	88	528	19,855
133	4,389	6,584	4,655	698	33	198	7,480
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—

LPHUR RIVER
RIVER

5. 35 LBS./ACRE - POTENTIAL HARVEST OF COMMERCIAL FISH
6. $0.15/LB. - AVERAGE COMMERCIAL FISH VALUE (FOOD AND NON-FOOD FISH)
7. 0.248 MAN-DAYS/ACRE - POTENTIAL WATERFOWL HUNTING
8. $6.00/MAN-DAY - VALUE OF WATERFOWL HUNTING

2

construction are expected from the utilization of underemployed labor. Moderate beneficial impacts are expected in property values and tax revenues. No net displacement of people will occur. Flood control will allow the conversion of current flood plain to unimproved and improved pasture with a net increase in grazing lands. There will be moderate beneficial impacts to the agricultural economy of the immediate area through the provision of flood protection.

(3) Operation and maintenance

(a) Structures and appurtenances. Reservoir regulation, accomplished in accordance with a prescribed regulation procedure for pool stage control will provide and sustain the flood control, water supply, and recreation benefits anticipated in the project plan. Maintenance of the structures will preserve their integrity and usefulness over the life of the project. Removal of growths, trash, and debris from shorelines, outlet works, and spillway is beneficial to proper pool regulation, is esthetically desirable, and is conducive to minimizing mosquito breeding habitat. Aquatic vegetation in the reservoir will be controlled to improve the recreational opportunities for boating and fishing and to reduce lake eutrophication.

(b) Recreation development. Operation and maintenance of recreation areas will propagate the recreation benefits enjoyed by the public users. Operation and maintenance activity will be beneficial to the environment in that it will be directed toward minimizing the adverse impacts associated with recreational use and perpetuating the worth of the resources available.

(c) Natural resource management. All proposed activity in this area is considered to have beneficial impacts. Forestry management will maintain vigorous timber stands for watershed protection, for wildlife habitat, and for increased esthetic value and will minimize the effects of fires and epidemics of fungal infections and insect infestations. Selective thinning for improvement of wildlife habitat will allow the development of an understory and will produce income which can be used to expand beneficial resource management programs. Fish and wildlife management will be associated with habitat improvement; stocking of selected species, fish, fowl, and small game animals; food plots for subsistence in winter and creating edge; and public use facilities for enjoyment of fish and wildlife resources. Interpretive programs in conjunction with natural resource and recreation management will be implemented to increase public awareness and appreciation of forest, recreation, water, fish and wildlife, historical, and cultural resources.

(d) Condition and operation studies. These studies include regular inspection of structures, review of permit requests for use of reservoir lands, range sedimentation analyses, water quality studies, etc. They provide information pertinent to assessing the general condition of the project and the effects of its continued operation.

(e) Support systems. Operation and maintenance of buildings and equipment will prevent deterioration of facilities so that a suitable useful life might be realized and the development of blight might be prevented.

(f) Land management. Real estate and land management activities are directed toward resource protection to effect maximum public accessibility and use with minimum damage. Boundary line marking delineates property owned by the government so that unauthorized encroachments, trespassing, or destruction of property can be controlled under the provisions of Title 36, CFR. Compliance with the terms of lease agreements is effected by periodic inspection and contract review.

b. Adverse impacts

(1) Reservoir

(a) Hydrological impacts

1. Flood control and water supply. A sediment storage of 37,000 acre-feet is reserved to allow for sediment deposits originating from the 476 square miles of drainage area above the Cooper Lake damsite. This buildup of sediments will cause a corresponding reduction in the total storage capacity of the reservoir during the project life. In the process of providing some degree of flood protection for approximately 13,000 acres of land below the damsite, approximately 3,400 acres between elevations 440 and 446.2 feet m.s.l. will be periodically inundated.

2. Water quality. The completion of Cooper Lake will permit 120,000 acre-feet of existing flood control storage space in Wright Patman Lake to be converted to water supply storage. If such storage conversion occurs, the increased water available for consumptive use will exert greater demands on the present municipal and/or industrial waste treatment facilities. If this occurs without the improvement or expansion of such facilities, a higher pollutional load will probably be discharged into the Sulphur River downstream of Wright Patman Lake. Also, Cooper Lake will tend to retain a portion of the upstream oxygen demanding

materials, which at the present time accumulate in Wright Patman Lake. The accumulation of these oxygen demanding materials, especially suspended solids and iron, in Cooper Lake could, in the future, result in an increased treatment cost of public water supplies. The underbrush and grass will remain on approximately 4,500 acres to be inundated by the lake and will decay over a period of time after the lake is filled. The biochemical oxygen demand generated from the decomposition of inundated vegetation can result in extreme diurnal oxygen fluctuations. In addition, the decaying vegetation could possibly cause some minor taste and odor problems in the reservoir, although this is not anticipated.

(b) Biological impacts

1. Aquatic ecosystems

a. Tributaries and tailwaters. Cooper Lake will permanently inundate 21 miles of the South Sulphur River. Regardless of the size of the river or the fact that it is an intermittent stream, all characteristics which distinguish streams from lakes will be lost due to this inundation. In addition to providing important habitat for many game fishes, the tributaries will support increased populations of problem fish such as carp.

b. Lake

(1). Thermal stratification. The expected thermal stratification in the lake will cause seasonal decreases in oxygen and pH and seasonal increases in CO_2, NH_3, and other dissolved gases and nutrients in the hypolimnion.

(2). Standing crops. A decrease in the diversity of benthos is expected, although an increase in standing crop is probable. Similarly, although an increase in abundance of phytoplankton is expected, a contrasting decrease in species diversity is also likely. Although an increase in the standing crop of sport and commercial fish is anticipated, in excess of 50 percent of the species occurring in the natural streams may be reduced or eliminated from the reservoir. At least two groups of fish will be adversely affected by the impoundment; these are the cyprinids (minnows) and the catastomids (suckers).

2. Land systems

a. Timber resources. Of the 9,200 acres of bottomland hardwoods in the total right-of-way needed for the reservoir, construction will result in the loss of 6,250 acres

of this total by clear cutting around the perimeter of the lake or by inundation by reservoir waters. Most bottomland hardwoods are tolerant of, and growth is generally enhanced by, periodic flooding during the dormant period. Permanent inundation, however, is highly detrimental and even the more flood tolerant species, e.g. baldcypress, tupelogum, and black willow, are killed within 5 to 8 years. Therefore, even those trees which are not cleared prior to inundation of the reservoir will be lost. The reservoir will provide protection from flooding on 3,200 acres of bottomland hardwoods below the damsite. Due to the nature of this area (sumps, bogs, etc.), however, it is estimated that approximately 80 percent (2,560 acres) of the timber will be cleared for agricultural purposes as a result of this flood protection.

b. Agricultural lands. Of the 20,800 acres of agricultural land (semiwooded or cleared areas) in the total right-of-way needed for the reservoir, construction will result in the loss of 14,175 acres from inundation by reservoir waters. The remainder of this area will be under Federal ownership, and this portion will also be lost to agricultural production. Much of this 6,625 acres is expected to undergo succession to forest during the project life. Although a total of 9,700 acres of agricultural land below the damsite will be provided flood protection, 8,200 acres of this total have already been cleared, and no further damages to the timber or wildlife resources are expected. The remaining 1,500 acres are semiwooded and further induced clearing on this area will adversely affect the present wildlife resources.

3. Terrestrial ecosystems

a. Flora. The existing flora on 14,175 acres of agricultural lands and 6,250 acres of bottomland hardwoods (i.e., about two-thirds of the the reservoir right-of-way) will be inundated and/or clear cut. The clearing of timber will extend 2 feet above the top of the water supply pool (440 m.s.l.) to elevation 442 m.s.l.; therefore, total area of direct impact is 20,425 acres. The agricultural area (semiwoods and cleared area), like the bottomland hardwoods, will be completely denuded of vegetation with permanent inundation. The most difficult impacts to assess regarding vegetation are those indirect impacts which will occur on lands protected from flooding below the reservoir. Of the 12,900 acres of protected lands, 3,200 acres are in bottomland hardwoods, 1,500 acres are semiwooded, and 8,200 acres are cleared. Although the 8,200 acres of cleared area will not likely undergo further vegetative change, the flood protection

provided for the wooded and semiwooded areas will probably lead to induced clearing of these areas.

b. Fauna

(1). Invertebrates. All of the terrestrial invertebrates will be killed or forced to emigrate from most of the 20,425-acre area of direct impact. If the flood protected lands are cleared and placed into row crops, the pesticides which are generally associated with this agricultural activity will adversely impact upon the invertebrate populations in these areas. If the area is pastured for livestock, use of pesticides would be limited and, accordingly, the adverse impacts would not likely be as severe unless herbicides are utilized for woody plant control.

(2). Amphibians and reptiles. As a result of reservoir construction, there will be a reduction in abundance, but not in species diversity. Terrestrial species will be eliminated from the impoundment area. In general, reservoir construction should result in a reduction in numbers of amphibians and reptiles, but all should remain common in the surrounding area.

(3). Birds. Approximately 300 species of birds are known from the Sulphur River Basin, and it is reasonable to assume that most utilize some portion of the area to be inundated. Nongame birds that are likely to be reduced in abundance as a direct result of habitat elimination include the passerines, birds of prey, and woodpeckers. The loss of cleared land and mixed successional stages of the semiwoods will severely reduce bobwhite populations in the project area. Inundation of the moist, alluvial flood plain, which is the main feeding area for woodcock, will greatly lower the woodcock population.

(4). Mammals. Most of the 42 species of mammals in the basin are expected to be affected by the impoundment. The most significant impacts will occur to those species which prefer moist bottomlands such as the shrew, and species primarily adapted to stream environments such as the beaver, mink, and river otter. The mink will continue to occur along the shoreline of the lake, but their numbers will be reduced in the project area. Beaver will be greatly reduced by inundation of the bottomland hardwoods that provide their preferred habitat. Muskrats will also be limited in the project area since fluctuations in the lake will prevent them from building lodges. Inundation or clearing of the bottomlands will virtually eliminate squirrel and rabbit habitat. The agricultural areas to be inundated provide a variety of successional stages and interspersion of habitat types that are

essential for maximum rabbit production. The only big game species that occurs in huntable numbers in the basin is the white-tailed deer. It is considered important to note that this species may lose the benefit of small agricultural units that currently supplement its natural food supply.

4. Endangered and threatened species. None of the plant species listed in the inventory of the Sulphur River Basin by East Texas State University (1971) are endangered or threatened. None of the endangered fauna will be adversely affected by the reservoir. The project will not adversely affect any known critical habitat for any threatened or endangered species.

(c) Recreational impacts (see table IV-4)

1. Consumptive recreation

a. Sport fishing. Inundation of the reservoir will result in the loss of 21 miles (42 surface acres) of natural river, causing a loss of 840 man-days of potential streamside sport fishing valued at $1,260.

b. Big game hunting. Big game hunting losses are based on the anticipated losses or alterations of bottomland hardwoods as a result of direct and indirect project impacts (table IV-5). Reservoir construction will result in the inundation and/or cutting of 6,250 acres of woodland. Of the 3,300 acres of reservoir right-of-way designated for development of general recreation areas, some 1,100 acres are in bottomland hardwoods. Since no hunting will be allowed on these general recreation areas, the potential for big game hunting is considered lost on these 1,100 acres. The reservoir will provide flood protection for 3,200 acres of bottomland hardwoods below the damsite; however, it is estimated that only 80 percent (2,560 acres) of this area would readily lend itself to clearing for agricultural purposes. Big game losses were, therefore, computed for only the 2,560 acres over which induced clearing can be expected. Accordingly, the project-induced losses or alterations of bottomland hardwoods total 9,910 acres. This acreage could potentially support 1,120 man-days of big game hunting valued at $6,720.

c. Small game hunting. In addition to bottomland hardwoods, most agricultural areas are known to support some potential for small game hunting. Reservoir construction will result in the inundation of 14,175 acres of agricultural areas (semiwooded or cleared). Of the 3,300 acres of right-of-way to be developed for general recreation, 2,200 acres are agricultural; the

potential for small game hunting on this area will be lost (table IV-5). Although a total of 9,700 acres of agricultural land below the dam will be protected from flooding, 8,200 acres of this total have already been cleared, and no further loss in hunting potential is expected. The remaining 1,500 acres are semiwooded and further clearing of this area will adversely impact upon the small game hunting potential. Accordingly, project-induced losses in potential small game hunting were computed for 9,910 acres of bottomland hardwoods and 17,875 acres of semiwooded and cleared lands. The total acreage (27,785 acres) could potentially support 5,111 man-days of small game hunting valued at $10,222.

d. Waterfowl hunting. Most of the waterfowl hunting in the basin involves harvesting wood ducks. Most of the area that is considered conducive to waterfowl hunting is bottomland hardwoods which are subjected to regular inundation. Hunting losses, therefore, are computed for the same acreage (9,910 acres) as big game hunting. This area could potentially support 396 man-days of waterfowl hunting valued at $2,376.

2. Nonconsumptive recreation. This is an activity in which the participant does not harvest game and fish species, as opposed to consumptive recreation which includes fishing and hunting. In the Sulphur River Basin, most of the nonconsumptive recreation is wildlife-oriented and includes such endeavors as bird-watching, nature study, and hiking. Most of these types of recreation are associated with forested areas. The only forested areas in the basin are of the bottomland hardwoods type, and these are capable of supporting one (1) man-day of wildlife-oriented recreation for every 2 acres of habitat. Losses attributed to project implementation are based on the 6,250 acres of bottomland hardwoods lost to reservoir construction and the 2,560 acres over which induced clearing can be expected. The 1,100 acres of bottomland hardwoods in the general recreation areas will continue to support nonconsumptive recreation; therefore, this area is not included in the computation of wildlife-oriented recreation losses. Accordingly, the project-induced losses of nonconsumptive recreation on 8,810 acres of bottomland hardwoods amount to 4,405 man-days valued at $6,608.

3. Commercial fishery resources. Although in the literal sense commercial fishing is not a form of recreation, quantitative losses in commercial fishery resources will be addressed here to facilitate a comparison of these losses to other quantifiable fish and wildlife resource damages. The 42 surface acres of natural river that will be lost by inundation of the

reservoir support a commercial fishery with the potential for an annual harvest of 2,100 pounds valued at $315.

4. Commercial furbearer resources. Data provided in 1974 by Mr. Bobby Alexander, biologist with the Texas Parks and Wildlife Department, showed that three furbearers (mink, raccoon, and opossum) are commercially harvested in the basin (reference table II-12). Analysis of these data indicated a harvest of one mink/200 acres, one raccoon/20 acres, and one opossum/57 acres. Under the assumption that the potential for such a harvest exists throughout the bottomland hardwoods of the basin, project-induced losses in commercial trapping were computed for the entire 9,910 acres of bottomlands which are expected to be lost to direct and indirect project features. An average value ($0.36 per acre of bottomland hardwoods) for fur production was used to calculate the project-induced monetary loss to fur trappers. (This average value was derived from the fur values of mink, raccoon, and opossum presented in "An Investigation of the 1972-73 and 1973-74 Texas Fur Harvests With Respect to Future Research and Management" by Mr. Dan Boone, Texas Parks and Wildlife Department). Accordingly, the total annual loss in the fur harvest attributable to this feature of the project has an estimated value of $3,568.

(d) Socioeconomic impacts. Project construction will produce substantial air and noise pollution; however, the area is sparsely settled. There is no human habitation within the taking line, thus the adverse social impacts would be minimized. Several roads and utility lines, and a number of graves must be relocated. Approximately 21,000 acres of agricultural land will be lost in right-of-way acquisition, which will be mitigated by the market price paid for lands acquired for project construction, operation, or maintenance.

(e) Archeological and historical impacts. An archeological survey of the Cooper Lake area was conducted in 1951 by Edward H. Moorman and Edward B. Jelks as part of the River Basin Surveys, then being conducted by the Smithsonian Institution. Twenty-four prehistoric sites were recorded, 15 of which were within the limits of the reservoir (Moorman and Jelks, 1952). The most recent survey, conducted by the Department of Anthropology, Southern Methodist University, revealed the locations of a total of 110 prehistoric sites, 90 of which will be directly affected by construction of the project (Hyatt and Skinner, 1970-1972). Twenty sites which lie above the 452-foot contour will not be inundated. No known historical sites will be affected by the project.

1. Types of sites affected. Of the 90 sites affected by the reservoir, 20 date back to the Archaic period,

WILDLIFE AND FISH

ALTERNATIVES	SOUTH SULPHUR RIVER INUNDATED, CHANNELED OR CUT OFF BY CHANNELS		SULPHUR RIVER CHANNELED OR CUT OFF BY CHANNELS		TOTAL ACRES OF RIVER LOST TO CHANNELIZATION	MAN-DAYS OF SPORT FISHERIES LOST [3]	SPOR FISHE LOSS (DOLLA
	MILES	ACRES [1]	MILES	ACRES [2]			
STATUS QUO	—	—	—	—	—	—	—
NONRESTRICTIVE EASEMENT	—	—	—	—	—	—	—
RESTRICTIVE EASEMENT	—	—	—	—	—	—	—
FEE PURCHASE	—	—	—	—	—	—	—
RESERVOIR ONLY	21	42	—	—	42	840	12
CHANNEL ONLY	41	82	71	554	636	12720	190
LEVEES ONLY	5	10	11	86	96	1920	28
RESERVOIR AND CHANNEL	34	68	70	546	614	12280	184
RESERVOIR AND LEVEES (SELECTED PLAN)	26	52	11	86	138	2760	41
CHANNEL AND LEVEES	33	66	65	507	573	11460	171
AUTHORIZED PLAN (DRAFT EIS PLAN)	34	68	65	507	575	11500	172
RESERVOIR, LEVEES, AND CHANNEL WITH LANDSIDE LEVEE BORROW	34	68	65	507	575	11500	172
RESERVOIR AND LEVEE ALINEMENT WITH CHANNEL ADJACENT TO THE LEVEES	34	68	65	507	575	11500	172
RESERVOIR AND CHANNEL ALINEMENT WITH LEVEES ADJACENT TO THE CHANNEL	34	68	65	507	575	11500	172
RESERVOIR AND LEVEE ALINEMENT WITH CLEARING AND SNAGGING OF THE RIVER	26	52	11	86	138	2760	41
RESERVOIR AND LEVEE ALINEMENT WITH CLEARING AND SNAGGING PLUS MAJOR BEND CUTOFFS	26	52	23	179	231	4620	69
RESERVOIR AND LEVEE ALINEMENT WITH SELECTED MAJOR BEND CUTOFFS	26	52	23	179	231	4620	69
RESERVOIR, LEVEES, AND CHANNEL CHANNEL BOTTOM RAISED 5 FEET	34	68	65	507	575	11500	172
RESERVOIR AND SELECTIVE FLOOD PROOFING BY RING LEVEES	21	42	15	117	159	3180	4
RESERVOIR WITH ANIMAL REFUGE MOUNDS	21	42	—	—	42	840	1
RESERVOIR AND NONRESTRICTIVE EASEMENT	21	42	—	—	42	840	1
RESERVOIR AND RESTRICTIVE EASEMENT	21	42	—	—	42	840	1
RESERVOIR AND FEE PURCHASE	21	42	—	—	42	840	1

1. 2.0 ACRES/MILE OF FISHABLE WATER ON THE SOUTH SULPHUR RIVER
2. 7.8 ACRES/MILE OF FISHABLE WATER ON THE SULPHUR RIVER
3. 20 MAN-DAYS ACRE POTENTIAL SPORT FISHING
4. $1.50 MAN-DAY VALUE OF SPORT FISHING
5. 50 LBS./ACRE POTENTIAL HARVEST OF COMMERCIAL FISH, FOOD AND NON-FOOD FISH
6. $0.15/POUND AVERAGE COMMERCIAL
7. 0.113 MAN-DAYS/ACRE POTENTIAL BI
8. $6.00/MAN-DAY VALUE OF BIG GAME
9. 0.229 MAN-DAYS/ACRE POTENTIAL SM
10. $2.00/MAN-DAY VALUE OF SMALL GA

Table IV-4

HERY LOSSES RELATED TO STRUCTURAL ALTERNATI

SPORT FISHERY LOSSES[4] (DOLLARS)	POUNDS OF COMMERCIAL FISHES LOST[5]	COMMERCIAL FISHERY LOSSES[6] (DOLLARS)	TOTAL FISHERY LOSSES (DOLLARS)	BOTTOMLAND HARDWOODS LOST FOR CONSUMPTIVE RECREATION (ACRES)	MAN-DAYS OF BIG GAME HUNTING LOST FROM BOTTOMLANDS[7]	BIG GAME HUNTING LOSSES[8] (DOLLARS)	MAN-DAYS OF SMALL GAME HUNTING LOST FROM BOTTOMLANDS[9]	SMALL GAME HUNTING LOSSES[10] (DOLLARS)	MAN-DAYS OF WATERFOWL HUNTING LOST FROM BOTTOMLANDS[11]	WATERFOWL HUNTING LOSSES[12] (DOLLARS)	SEMIWO AND CLE LANDS L FOR CONSUM RECREA (ACR
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
1260	2100	315	1575	9910	1120	6720	2269	4538	396	2376	178
19080	31800	4770	23850	38600	4362	26172	8839	17678	1544	9264	132
2880	4800	720	3600	10860	1227	7362	2487	4 974	434	2604	54
18420	30700	4605	23025	38350	4334	26004	8782	17564	1534	9204	249
4140	6900	1035	5175	17470	1974	11844	4001	8002	699	4194	198
17190	28650	4298	21488	11320	1279	7674	2592	5184	453	2718	54
17250	28750	4313	21 563	17830	2015	12090	4083	8166	713	4278	198
17[illegible]	28750	4313	21563	18070	2042	12252	4138	8276	723	4338	199
17250	28750	4313	21563	17830	2015	12090	4083	8166	713	4278	198
17250	28750	4313	21563	19830	2241	13446	4541	9082	793	4758	198
4140	6900	1035	5175	18790	2123	12738	4303	8606	752	4512	200
6930	11550	1733	8663	18410	2080	12480	4216	8432	736	4416	199
6930	11550	1733	8663	17590	1988	11928	4028	8056	704	4224	197
17250	28750	4313	21563	17910	2024	12144	4101	8202	716	4296	198
4770	7950	1193	5963	16170	1827	10962	3703	7406	647	3882	179
1260	2100	315	1575	9910	1120	6720	2269	4538	396	2376	17
1260	2100	315	1575	9910	1120	6720	2269	4538	396	2376	17
1260	2100	315	1575	9910	1120	6720	2269	4538	396	2376	17
1260	2100	315	1575	9910	1120	6720	2269	4538	396	2376	17

CIAL FISHERY VALUE, FOOD AND NON-FOOD FISH
AL BIG GAME HUNTING
AME HUNTING
AL SMALL GAME HUNTING
LL GAME HUNTING

11. 0.040 MAN-DAYS/ACRE POTENTIAL WATERFOWL HUNTING
12. $6.00/MAN-DAY-VALUE OF WATERFOWL HUNTING
13. 0.159 MAN-DAYS/ACRE POTENTIAL SMALL GAME HUNTING
14. 0.500 MAN-DAYS/ACRE OF BOTTOMLANDS POTENTIAL WILDLIFE-ORIENTED RECREATION
15. $1.50/MAN-DAY-VALUE OF WILDLIFE-ORIENTED RECREATION
16. $0.36/ACRE OF BOTTOMLAND HARDWOOD - ESTIMATED FUR RETURN TO THE TRAPPER

NO
of
of
los
ha
wi
a r

...TURAL ALTERNATIVES

...NG ...DS[9]	SMALL GAME HUNTING LOSSES[10] (DOLLARS)	MAN-DAYS OF WATERFOWL HUNTING LOST FROM BOTTOMLANDS[11]	WATERFOWL HUNTING LOSSES[12] (DOLLARS)	SEMIWOODS AND CLEARED LANDS LOST FOR CONSUMPTIVE RECREATION (ACRES)	MAN-DAYS OF SMALL GAME HUNTING LOST FROM SEMIWOODS AND CLEARED LAND[13]	SMALL GAME HUNTING LOSSES[10] (DOLLARS)	TOTAL HUNTING LOSSES (DOLLARS)	MAN-DAYS OF WILDLIFE-ORIENTED RECREATION LOST[14]	WILDLIFE-ORIENTED RECREATION LOSSES[15] (DOLLARS)	COMMERCIAL FUR TRAPPING LOSSES[16] (DOLLARS)	TOTAL WILDLIFE AND FISHERIES LOSSE... (DOLLARS)
	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
	4538	396	2376	17875	2842	5684	19318	4405	6608	3568	31069
	17678	1544	9264	13200	2099	4198	57312	19300	28950	13896	124008
	4974	434	2604	5400	859	1718	16658	5430	8145	3910	32313
	17564	1534	9204	24975	3971	7942	60714	18625	27938	13806	125483
	8002	699	4194	19875	3160	6320	30360	8185	12278	6289	54102
	5184	453	2718	5400	859	1718	17294	5660	8490	4075	51347
	8166	713	4278	19875	3160	6320	30854	8365	12548	6419	71384
	8276	723	4338	19975	3176	6352	31218	8485	12728	6505	72014
	8166	713	4278	19875	3160	6320	30854	8365	12548	6419	71384
	9082	793	4758	19875	3160	6320	33606	9365	14048	7139	76356
	8606	752	4512	20075	3192	6384	32240	8845	13268	6764	57447
	8432	736	4416	19975	3176	6352	31680	8655	12983	6628	59954
	8056	704	4224	19775	3144	6288	30496	8245	12368	6332	57859
	8202	716	4296	19875	3160	6320	30962	8405	12608	6448	71581
	7406	647	3882	17975	2858	5716	27966	7535	11303	5821	51053
	4538	396	2376	17875	2842	5684	19318	4405	6608	3568	31069
	4538	396	2376	17875	2842	5684	19318	4405	6608	3568	31069
	4538	396	2376	17875	2842	5684	19318	4405	6608	3568	31069
	4538	396	2376	17875	2842	5684	19318	4405	6608	3568	31069

...RFOWL HUNTING
...UNTING
...L GAME HUNTING
...-POTENTIAL WILDLIFE-ORIENTED RECREATION
...ENTED RECREATION
...D - ESTIMATED FUR RETURN TO THE TRAPPER

NOTE: 1,100 acreas of bottomland hardwoods in the 3,300 acres of general recreation area of the reservoir will support this form of nonconsumptive recreation, however, this area is potentially lost for consumptive recreation. Accordingly, bottomland hardwood losses are decreased by 1,100 acreas for calculating wildlife-oriented recreation losses for all alternatives containing a reservoir.

3

based on diagnostic artifacts such as projectiles and/or pottery. This represents about 22 percent of the sites to be inundated by the reservoir. The Caddoan period is represented by approximately 8 percent of the sites to be affected, and another 20 percent of the sites are both Archaic and Caddoan. Approximately 50 percent of the sites to be inundated could not be classified according to time periods due to the lack of diagnostic artifacts (Hyatt and Skinner, 1971).

2. Site investigations. It is anticipated that along with the previous excavation seasons, the work completed in the summer of 1976 will, in the opinion of Alan Skinner, Ph. D., Director of the Archeology Research Program at Southern Methodist University, fulfill the requirements "to provide minimum mitigation of the loss of archeological resources in the Cooper Lake area." Inundation of archeological sites does not necessarily imply destruction of these sites. Submerged sites should be considered only temporarily inaccessible since their cultural resource value is preserved for future generations. Ten sites, which appeared to be the most promising in the reservoir area already have been thoroughly examined. They are as follows: X41DT 1, X41DT17, X41DT20, X41DT57, X41DT19, X41DT36, X41DT37, X41HP7, X41HP34, and X41HP37.

3. Final research efforts. To complete the research effort at Cooper Lake, the following objectives supported by the Corps of Engineers were planned for the final season (1976): (1) testing and evaluation of fourteen (14) selected sites identified by earlier investigations and (2) an evaluation of the historical cultural resources. The report of findings should be completed in late summer of 1977. Based on determination of significance, appropriate plans will be developed for additional salvage and/or mitigation to be accomplished on resumption of construction.

(2) Levees and channels

(a) Hydrological impacts. Placement of the levees will require approximately 34,900 feet of additional realined channel. Although this excavation is significantly less than that initially envisioned for the draft EIS plan, some potential for increased sediment contribution into Wright Patman Lake does exist. Based on enlargement rates of previously improved channels in the Sulphur River Basin, channel excavation associated with the selected plan has a potential sediment contribution of 1,600 acre-feet within the initial 10-year period following construction. Because of the discontinuity of the channelization, much of this sediment load will be deposited in the flood plain of the South Sulphur and Sulphur Rivers. Realistically, however, some portion of the

potential sediment load will eventually reach Wright Patman Lake. Consequently, some increase in the cost of drinking water treatment could be experienced by users from Wright Patman Lake. Additionally, some increase in the iron (Fe) concentration of Wright Patman Lake waters could result from the channel excavation.

(b) Biological impacts

1. Aquatic ecosystems

a. Channels. Construction of the levees will require the realinement of 5 miles of the South Sulphur River and 11 miles of the Sulphur River where proposed levees would cut off the natural channel. Long-term impacts on existing stream ecosystems include the loss of riparian cover (resulting in an overall increase in water temperatures), increased current velocities, altered hydrologic regimes, increased turbidity (resulting in temporary decreases in water temperatures), and a reduction in habitat diversity. Land use changes, such as clearing, will also result in faster runoffs and increases in turbidity. Increased agricultural activity will result in increased levels of insecticides, herbicides, and fertilizers in the aquatic ecosystem. Input of allochthonous organic material will be reduced. Since this constitutes a primary energy source for lotic ecosystems, the productivity of streams will be decreased. The reduction of flooding will have adverse effects on existing oxbows and side channels. Overbank flooding is generally considered essential to the maintenance of productive fisheries.

(1). Plankton. Most of the plankton recorded from the basin require standing water. Streams typically support a limited plankton community, and the Sulphur River system is no exception. Channelization should further depress the plankton population. Higher turbidity and increased water velocities, the removal of streamside vegetation and debris, and the decrease in overflow areas will reduce both diversity and standing crops. Increased agricultural chemicals could also decrease plankton populations.

(2). Benthic fauna. The standing crop of benthic invertebrates would be greatly reduced by channelization. Diversity, also, would decrease as pools and riffles are replaced by the straight line channel. Invertebrates which would decline or be eliminated include some of the adult crustaceans and corixids, plus the immature stages of such insects as mayflies and caddis flies. Benthic communities in the newly formed oxbows may be adversely affected by sedimentation, low levels of dissolved

oxygen, and the loss of stream flow. Species composition in these "cutoff" channels will change from those requiring flowing waters to those better adapted to the lentic environment.

(3). Fish. The impacts of channelization on fishes are primarily related to the lost streamside vegetation, increase in current velocity, drastic fluctuations in water temperature, increase in turbidity, reduction in habitat diversity, and associated changes in land use. As indicated by fish samples taken from the North Sulphur River and Cuthand Creek, the number of species of fishes in the channel will be reduced. A total of 84 species of fishes have been collected from the entire Sulphur River Basin while only 13 species were collected from the North Sulphur River and 12 species from Cuthand Creek, areas which have already been channelized. Collections made in the South Sulphur River revealed 20 species from the unchannelized portion of the stream and 18 species from the channelized portion. This channelized portion has gradually recovered and now provides essentially the same types of aquatic habitats as the unchannelized portions. In general, channelization will reduce the numbers of species and standing crops in the remaining unchannelized portions of the river.

(4). Vectors. Channel construction will deny habitat to temporary water breeders such as Aedes sp. Oxbows created by channel realinement and borrow areas utilized for levee construction will revert to habitat for permanent water breeders such as Anopheles sp. and Culex sp.

b. Levees. Establishment of the required levees involves borrow excavation, with subsequent formation of a limited number of riverside borrow ditches. These pits may benefit fishing in the area; but again, high production levels are closely correlated to periodic overflows. Localized turbidity is expected to develop in response to erosion of newly formed or uplifted levees and enlargement of new channels.

2. Land systems

a. Timber resources. Some 600 acres of bottomland hardwoods will be utilized as right-of-way for levees and channel construction. Most of this area will be cleared for construction of levees, with the remaining timber losses being attributed to the deposition of dredged material and to the conversion of land to water as a result of channel construction. Although the acreage utilized specifically for levees and channel construction will no longer support timber, the disposal areas will

likely succeed to a forested state within 25 to 50 years. The levees will provide flood protection to 8,700 acres of bottomland hardwoods, and it is estimated that about 80 percent (6,960 acres) of the timber will be cleared as a result of this flood protection.

b. Agricultural lands. Approximately 200 acres of agricultural land (semiwooded or cleared areas) are included in the total right-of-way (800 acres) needed for construction of the levees and channel. As with the timber resources, almost all of this area will be, at least initially, adversely affected by construction. The rather small portion of this area which will be used for disposal may eventually succeed to forest. Although a total of 2,700 acres of agricultural land will be provided flood protection, 900 acres of this total have already been cleared and no further detrimental change is expected. The remaining 1,800 acres are semiwooded and further induced clearing on this area is possible.

3. Terrestrial ecosystems

a. Flora. Most of the natural vegetation on the levees and channel R.O.W. will be destroyed. Only the disposal areas can be expected to eventually regain, in time, some semblance of the natural habitat prior to construction. The limited area required for channels will be permanently denuded. After construction, the levees will be seeded to Bermuda grass; however, a return to higher stages of succession will not be allowed.

b. Fauna

(1). Invertebrates. All of the terrestrial invertebrates will be killed or forced to emigrate from the entire 800 acres of R.O.W. Once construction is complete, however, most of this area, e.g., levees and disposal sites, will again support a diversity of invertebrates. Just as previously discussed under the reservoir impacts, the severity of the impact of induced clearing on invertebrate populations will ultimately depend on land-use trends.

(2). Amphibians and reptiles. Essentially all reptiles and amphibians that are likely to be affected by construction features are either closely associated with or dependent on the existing stream bottoms. Most amphibians are dependent on standing water for reproduction while many snakes and lizards are reliant upon damp or heavily shaded habitat for survival. Project construction and induced clearing for agricultural purposes will reduce the abundance and diversity of those

species favoring moist, shady habitats. Many of the arboreal lizards such as the green anole, five-lined skink, broad-headed skink, Texas spiny lizard, and the fence lizard will be reduced by clearing, but all are expected to remain common.

(3). Birds. The birds that are most likely to be affected by the loss of the hardwoods, due directly to project features and indirectly to induced clearing, are the arboreal nesters. These include the sparrows, flickers, cuckoos, woodpeckers, warblers, vireos, flycatchers, thrashers, orioles, mockingbirds, kinglets, numerous birds of prey, and two game birds, the mourning dove and the wood duck. Species that depend on moist, woodland areas for feeding will also be adversely affected. These include the heron, ibis, egret, bittern, belted kingfisher, and woodcock. Waterfowl, especially the wood duck, that depend heavily on mast producing hardwoods for food would be severely decreased.

(4). Mammals. Significant reductions are expected in localized populations of species which prefer moist bottomland hardwoods. This becomes critical where large acreages of forest will no longer be subjected to overflow and where actual land requirements for project construction plus flood protection have caused complete clearing of the trees and shrubs. Species such as the beaver, mink, river otter, gray squirrel, swamp rabbit, and white-tailed deer will be adversely affected.

4. Endangered and threatened species. The range of the alligator extends into the Sulphur River Basin, but the extent of local populations is not known. Therefore, it is difficult to assess the impacts to this reptile. It is sufficient to say that this project feature will severely decrease the amount of wetland habitat available, thereby decreasing populations which are present now, and preclude any restocking efforts in the future. The project will not adversely affect any known critical habitat for any threatened or endangered species.

(c) Recreational impacts (see table IV-4)

1. Consumptive recreation

a. Sport fishing. Construction of the conveyance channel will result in the realinement of 16 miles (96 surface acres) of natural channels of the South Sulphur and Sulphur Rivers. This will eliminate 1,920 man-days of potential streamside sport fishing which has a value of $2,880.

b. Big game hunting. Big game hunting losses are based on the anticipated losses or alterations of

bottomland hardwoods as a result of direct and indirect impacts from construction of the levees. Although we recognize that the portion of the R.O.W. in levees and disposal area will support some unquantifiable amount of wildlife recreation resource by the mere fact that it will form an ecotone between the remaining bottomland hardwoods and the agricultural areas (table IV-5), losses are computed for the total bottomland hardwoods area (600 acres) in the construction R.O.W. In addition, losses are attributed to 80 percent (6,960 acres) of the 8,700 acres of bottomland hardwoods which will be protected from flooding and which are expected to be cleared for agricultural purposes. Accordingly, project induced losses for a total of 7,560 acres of bottomland hardwoods are 854 man-days of big game hunting valued at $5,124.

c. Small game hunting. Small game hunting losses are based on the acreage of bottomland hardwoods and agricultural lands that will be lost or altered by project implementation. In addition to project induced losses of 7,560 acres of bottomland hardwoods, 200 acres of agricultural land will be lost to project construction and another 1,800 acres of semiwooded area will be protected from flooding and are expected to undergo induced clearing (table IV-5). The total (9,560 acres) supports a potential of 2,050 man-days of small game hunting valued at $4,100.

d. Waterfowl hunting. Waterfowl hunting losses are computed for the 7,560 acres of bottomland hardwoods which will be lost or altered by project implementation. The losses are 303 man-days valued at $1,818.

2. Nonconsumptive recreation. The project induced losses of wildlife-oriented recreation are computed for the 7,560 acres of bottomland hardwoods lost or altered either directly or indirectly by construction of the levees. These losses amount to 3,780 man-days valued at $5,670.

3. Commercial fishery resources. The 96 surface acres of natural river that will be lost by construction of the limited channel support a commercial fishery with the potential for an annual harvest of 4,800 pounds valued at $720.

4. Commercial furbearer resources. Losses in commercial harvest of furbearers are based on the anticipated losses or alterations of bottomland hardwoods as a result of the direct impact of construction of the levees and the indirect impact of induced clearing as a result of the flood protection benefits provided by the levees. Accordingly, project-induced losses in fur

harvest over a total of 7,560 acres of bottomland hardwoods have an estimated value of $2,721, annually.

(d) Socioeconomic impacts. Construction of the levees will produce substantial adverse air and noise impacts as well as a deterioration in water quality. Several bridges, pipelines, and powerlines will require relocation. Adverse esthetic impacts will occur due to minor conversions of land to channels and disposal areas.

(e) Archeological and historical impacts. No archeological sites will be affected by raising existing levees within the vicinity of the reservoir. Downstream from the damsite, the new levee at river mile 152 could possibly affect one large site (TT 40) located approximately 0.5 miles west of the end of the levee. Flakes and artifacts have been found in a road cut which crosses the site, but the entire mound surface is assumed to have been occupied. If this site, or any other site which might be discovered during construction, cannot be avoided, it will be evaluated for mitigation or salvage as required by the Moss-Bennett Act (Public Law 93-291). No other known cultural resource will be affected.

(3) Operation and maintenance

(a) Structures and appurtenances. Control of pests (burrowing rodents, vegetation in riprap slopes, aquatic growths) will be accomplished by the application of pesticides and herbicides. This activity contributes to environmental pollution. Mitigation of consequences of this action will be effected through training of personnel, judicious selection of chemicals (EPA approved), and application of only the dosage required to control the specific pest. Reservoir regulation will cause varying pool stages which in conjunction with wind and wave action will contribute to shoreline erosion.

(b) Recreation developments. There are no significant adverse impacts of operation and maintenance activity since the work is accomplished to minimize the effects of compaction, erosion, understory destruction, damage to trees, accumulation of solid wastes, generation of waterborne sanitary wastes, and dredging of boat launching ramps. Traffic control, forest management, facilities improvements, application of citation program (Title 36 CFR), routine collection and disposal of trash, maintenance of sewage disposal systems, and ground cover rehabilitation are all activities which will routinely be performed in the operation and maintenance of recreation areas. Dredged material from maintenance

of boat launching ramps will be hauled from the site and be stockpiled at sanitary landfills for use as cover material.

(c) Natural resource management. There are no significant adverse impacts associated with natural resource management activities. Fish and wildlife management and forestry management activities are designed for enhancement of habitat, propagation of species, and protection of resources. Localized temporary disturbance of natural environmental setting will be associated with silvicultural practices and light construction activities for enhancement of fish and wildlife habitat.

(d) Condition and operation studies. These studies serve to assess the effect of the operation and maintenance (O&M) of the project in an effort to minimize the adverse effects of this O&M.

(e) Support systems. Operation of equipment requires an irreversible commitment of energy resources and contributes to noise and air pollution.

(f) Land management. There are no adverse impacts due to land management activities, except for the granting of grazing leases. Grazing leases contribute to erosion and water pollution, to destruction of browse and vegetative cover needed for wildlife, and to prevention of regeneration of hardwood species in forested areas due to cattle eating or trampling seedlings. Mitigation measures will consist of excluding grazing to the greatest extent possible from woodland areas and restricting grazing of open areas consistent with the carrying capacity of the land.

c. Remedial, protective, and mitigation measures

(1) Esthetics and access. The major construction areas, including the damsite, emergency spillway, etc., will be landscaped to provide a pleasing appearance. Access to the reservoir area is available by Texas State Highway Nos. 11, 24, and 154, and farm to market road Nos. 64, 71, and 1880. In general, these roads, supplemented by existing county roads, would provide good access to the damsite and the proposed public use areas. However, it is proposed to construct an additional 14.3 miles of access roads in order to assure maximum use of the project by the public. Levees would be graded and then planted with Bermuda grass to insure stability and to ameliorate the scars of construction.

(2) General recreation. Seven sites totaling 3,300 acres of land, within the fee title taking line established for the

reservoir, would be developed for general recreation. Facilities would be provided to accommodate the estimated initial visitation of 741,000 annual visitors. Facilities would be located so as to utilize and to enhance the surrounding natural beauty of the sites. Landscaping would be accomplished to complement the available natural beauty and to reestablish vegetation over the necessary construction sites.

(3) Wildlife and fishery resources

(a) Fish and Wildlife Agency requests. A 13 July 1966 letter report from the regional director of the US Fish and Wildlife Service (incorporated as part of appendix F on file at the New Orleans District office) recommended implementation of the following eight measures in the interest of fish and wildlife preservation and development:

1. The Texas Parks and Wildlife Department be given the opportunity of selecting and administering a suitable tract of project lands for wildlife management;

2. The 1,200 acres of reservoir lands proposed for easement acquisition be acquired in fee title as mitigation for project-induced losses of wildlife habitat;

3. The minimum low-flow release from Cooper Lake during the period June through December be 10 cubic feet per second (c.f.s.) and 16 c.f.s., respectively, for the first and second 50 years of project life;

4. The project provide for bank fisherman access and needs at the Cooper Dam tail water;

5. Seining areas be provided in Cooper Lake in accordance with needs and specifications to be established by the Texas Parks and Wildlife Department;

6. Eight bendways cutoff by channel realinement be developed as fishing lakes with provision made for public access to each lake;

7. Minimum flows of no less than 100 cfs from Wright Patman Lake be maintained during summer months and, if excess storage is available, higher flows from mid-October through December of each year; and,

8. Initial release of the Wright Patman Lake summer pool be delayed until October 15.

The report was reviewed and concurred in by the Bureau of Commercial Fisheries, the Arkansas Game and Fish Commission, and the Texas Parks and Wildlife Department.

(b) Proposed Corps actions. In the course of project planning, the following actions have been or will be taken:

1. The Texas Parks and Wildlife Department will be given the opportunity of selecting and administering a suitable tract of project land for wildlife management. Within the fee title taking line for the reservoir, approximately 6,000 acres of land, in addition to the 3,300 acres dedicated to general recreation developments, lie outside of the water supply pool. This area, or a portion of it, could be dedicated to fish and wildlife purposes, provided a detailed management plan were submitted to and approved by higher authority.

2. The 1,200 acres of reservoir lands originally proposed for easement acquisition have already been acquired in fee as part of the project required land purchase. This area is part of the 6,000 acres referred to in item 1. above.

3. The minimum low flow release from Cooper Lake will be 5 c.f.s. When water levels exceed the top of the water supply pool (440 m.s.l.), a release in excess of 5 c.f.s. can be expected, to a maximum release of 3,000 c.f.s. The discharges will be in accordance with a schedule based on the ratio of the Cooper Lake flood control pool percent occupied to the Wright Patman Lake flood control pool percent occupied.

4. Facilities and access will be provided at the Cooper Dam tailwater for bank fishermen.

5. Designation of seining areas was coordinated with the Texas Parks and Wildlife Department. The reservoir clearing plans now provide for clearing, grubbing, and grading of 654 acres within seven seining areas. These areas will be graded with a resultant smooth ground surface with no abrupt projections or depressions. No deviations of more than 1 foot in 10 feet in any direction will be permitted other than the changes in the natural terrain. In connection with clearing operations in the reservoir area, boat passage lanes will be provided to enhance recreational access and marine safety. These boat lanes and seining areas will be appropriately designated by navigation aids and marker buoys. A detailed report on reservoir master plans for recreational development will be prepared in the future. This

report will adequately address the physical dimensions and design requirements of these features as well as the feasibility of constructing fishing reefs with cleared timber, old tires, or rock rubble and the feasibility of constructing lighted fishing piers.

6. With the newly selected plan, channelization, cutoffs, and the associated formation of oxbows will be minimized. Where appropriate, however, earthen plugs will be placed across the old river channel to help confine low river flows to the newly alined channel. These plugs will still allow overtopping during high flows and, accordingly, this should result in the establishment of highly productive oxbow lakes. The possibility of providing access routes to these oxbow lakes was examined; however, the benefits to be derived from these lakes were not sufficient to justify the costs of constructing the access routes.

7. The present rule curve operation at Wright Patman Lake will be maintained. This operational plan provides for a release rate of 96 c.f.s. during the months of May through October when the water supply commitments permit. When lake levels are below elevation 220 m.s.l., releases will equal 10 c.f.s. When lake levels are above the rule curve, flood releases will be provided on a predetermined schedule up to 10,000 c.f.s.

8. The approved operational plan is intended to assure adequate vector control and to assure adequate flood control storage space prior to the flood season. Those factors preclude the retention of high reservoir levels through the summer months.

(4) Vector control

(a) Recommendations for vector control. In a letter dated 6 July 1976, commenting on the draft environmental impact statement, Dr. Richard O. Hayes, Chief of the Water Resources Branch, Vector-Borne Diseases Division of the US Public Health Service, suggested that the Corps contact Mr. Kenneth Lauderdale, Director of the Vector Control Division, Texas State Department of Health, to gain insight into methods the Corps might employ to alleviate problems which could be created by the proposed project. In a telephone conversation on 26 August 1976, Mr. Bobby Davis, entomologist with the Vector Control Division of the Texas State Department of Health, suggested that the proposed project should provide for the following:

1. Source reduction which includes reducing mosquito breeding areas by clearing dense underbrush and cover

around the perimeter of the reservoir, by filling potholes and other areas which could trap water, by allowing only a minimum of aquatic vegetation along the reservoir banks, and by removing all floating debris;

2. Surveillance to insure against the emergence of abnormally high population densities of mosquitoes;

3. Maintenance of constant water levels in the reservoir;

4. A chemical control program designed for use when surveillance indicates the vector potential has reached levels which would constitute a health hazard.

(b) Proposed Corps actions to alleviate vector problems

1. Reservoir clearing. The perimeter of the reservoir will be cleared to an upper limit of 442.0 m.s.l., which is 2 feet above the water supply pool. The lower limit of clearing will be elevation 418.0 m.s.l., which is 5 feet below the 10-year frequency drawdown. Horizontal limits of the proposed clearing include clearing within 1 mile of the dam, each primary public-use area, and each existing or proposed major populated area; and within one-half mile of each highway or railroad crossing the reservoir and each smaller public-use area. No clearing will be accomplished in isolated areas and tributaries where hazards to public health are not evident. The proposed reservoir clearing described here should be adequate to provide vector control. The perimeter of the reservoir will be filled and graded to eliminate depressions and potholes. This will also allow for marginal drainage to assure that potential mosquito breeding areas do not develop.

2. Reservoir level management. Normally, reservoir water levels will be maintained at 440.0 feet m.s.l., thus allowing for activities of predator organisms. In the interest of vector control, a recession of water level at a rate of 0.2 feet in every 10-day period during the months of May through October will be insured should the need arise.

3. Vector surveillance. Preimpoundment and postimpoundment surveillance programs will be established to determine the effect of reservoir construction on mosquito populations. Suspected vector breeding sites will be closely monitored. The information derived would allow for the implementation of appropriate control measures designed to reduce population densities.

4. Chemical control. A chemical control program, including presently recommended procedures for larviciding and adulticiding, will be used when vector densities approach levels considered potentially hazardous to health and welfare.

5. Vegetation control. Secondary vegetative growth and submergent and emergent aquatic vegetation around the perimeter of the reservoir will be removed as necessary, after impoundment, to eliminate the accumulation of vector breeding habitat.

(5) Secondary development. Induced secondary development in wetlands of the area will be subject to the regulatory jurisdictions delegated to the Corps of Engineers under Section 10 of the River and Harbor Act of 1899 (30 Stat. 1151; 33 USC 403) and Section 404 of the Federal Water Pollution Control Act (PL 92-500, 86 Stat. 816).

around the perimeter of the reservoir, by filling potholes and other areas which could trap water, by allowing only a minimum of aquatic vegetation along the reservoir banks, and by removing all floating debris;

2. Surveillance to insure against the emergence of abnormally high population densities of mosquitoes;

3. Maintenance of constant water levels in the reservoir;

4. A chemical control program designed for use when surveillance indicates the vector potential has reached levels which would constitute a health hazard.

(b) Proposed Corps actions to alleviate vector problems

1. Reservoir clearing. The perimeter of the reservoir will be cleared to an upper limit of 442.0 m.s.l., which is 2 feet above the water supply pool. The lower limit of clearing will be elevation 418.0 m.s.l., which is 5 feet below the 10-year frequency drawdown. Horizontal limits of the proposed clearing include clearing within 1 mile of the dam, each primary public-use area, and each existing or proposed major populated area; and within one-half mile of each highway or railroad crossing the reservoir and each smaller public-use area. No clearing will be accomplished in isolated areas and tributaries where hazards to public health are not evident. The proposed reservoir clearing described here should be adequate to provide vector control. The perimeter of the reservoir will be filled and graded to eliminate depressions and potholes. This will also allow for marginal drainage to assure that potential mosquito breeding areas do not develop.

2. Reservoir level management. Normally, reservoir water levels will be maintained at 440.0 feet m.s.l., thus allowing for activities of predator organisms. In the interest of vector control, a recession of water level at a rate of 0.2 feet in every 10-day period during the months of May through October will be insured should the need arise.

3. Vector surveillance. Preimpoundment and postimpoundment surveillance programs will be established to determine the effect of reservoir construction on mosquito populations. Suspected vector breeding sites will be closely monitored. The information derived would allow for the implementation of appropriate control measures designed to reduce population densities.

4. Chemical control. A chemical control program, including presently recommended procedures for larviciding and adulticiding, will be used when vector densities approach levels considered potentially hazardous to health and welfare.

5. Vegetation control. Secondary vegetative growth and submergent and emergent aquatic vegetation around the perimeter of the reservoir will be removed as necessary, after impoundment, to eliminate the accumulation of vector breeding habitat.

(5) Secondary development. Induced secondary development in wetlands of the area will be subject to the regulatory jurisdictions delegated to the Corps of Engineers under Section 10 of the River and Harbor Act of 1899 (30 Stat. 1151; 33 USC 403) and Section 404 of the Federal Water Pollution Control Act (PL 92-500, 86 Stat. 816).

AD-A100 099 ARMY ENGINEER DISTRICT NEW ORLEANS LA F/G 13/2

COOPER LAKE AND CHANNELS, TEXAS.(U)

APR 77

UNCLASSIFIED NL

3 OF 5

AD A100099

SECTION 5--ANY PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

5.01 HYDROLOGICAL IMPACTS

The reduction in velocity of flow entering Cooper Lake will allow the sediment load presently being carried by the stream to drop out. The buildup of sediments will cause a reduction in the total storage capacity of the reservoir during the project life. Erosion of the conveyance channel associated with the selected plan will result in the creation of about 1,600 acre-feet of sediment in the 10-year period following construction, much of which will be deposited in the flood plain. However, some portion of this sediment will be deposited in Wright Patman Lake. Temporary adverse water quality can be expected due to the release of minerals into surface waters, as well as a temporary increase in suspended solids.

5.02 BIOLOGICAL IMPACTS

a. Reservoir. Construction of the reservoir will result in the displacement of 21 miles of natural river by the lake. In excess of 50 percent of the fish species presently occurring in the natural river may be reduced or eliminated from that reach of the river that will be inundated by the lake. The inundation of approximately 19,000 acres and the induced clearing of 4,060 acres of terrestrial habitat will result in significant losses in terrestrial flora and fauna. Most severely affected will be those organisms dependent on a moist bottomland hardwoods environment.

b. Levees and channels. Construction of the levees will result in the realinement of 16 miles of natural river channel. Impacts include the loss of riparian cover, increased current velocities, increased turbidity, and reduction in habitat diversity. Accordingly, both the standing crop and species diversity of aquatic fauna will be adversely affected. The levees and channels feature of the selected plan will result in the direct loss or modification of 800 acres of terrestrial habitat through construction and an additional 8,760 acres due to induced clearing. Adverse impacts to flora and fauna will be similar to those resulting from habitat losses in reservoir construction.

5.03 RECREATIONAL IMPACTS

a. Reservoir. Inundation of 21 miles of riverine environment by the reservoir will result in the loss of 840 man-days of potential streamside sport fishing and the loss in potential for an annual harvest of 2,100 pounds of commercial fish. The terrestrial habitat lost directly to project construction or indirectly to induced clearing will result in a loss in annual potential of 1,120 man-days of big game hunting, 5,111 man-days of small game hunting, 396 man-days of waterfowl hunting, 4,405 man-days of nonconsumptive (wildlife-oriented) recreation, and a commercial fur harvest valued at $3,568.

b. Levees and channels. Construction of the limited channels will result in the loss of 1,920 man-days of potential streamside sport fishing and the potential for an annual harvest of 4,800 pounds of commercial fish. The direct and indirect loss or modification of terrestrial habitat by construction of the levees and channel will result in a loss in annual potential of 854 man-days of big game hunting, 2,050 man-days of small game hunting, 303 man-days of waterfowl hunting, 3,780 man-days of wildlife-oriented recreation, and a commercial fur harvest valued at $2,721.

5.04 SOCIOECONOMIC IMPACTS

Construction of the proposed project will produce substantial air and noise impacts as well as a deterioration in water quality. Several roads, bridges, pipelines, powerlines, and graves will require relocation. Adverse esthetic impacts will occur due to substantial conversions of land to levees.

5.05 ARCHEOLOGICAL IMPACTS

Construction of the project will inundate 90 archeological sites in the reservoir area and could adversely affect one site below the damsite. According to Dr. Alan Skinner, Director of the Archeology Research Program at Southern Methodist University, with completion of the excavations scheduled for the summer of 1976, minimum mitigation of the loss of archeological resources in the Cooper Lake area will have been accomplished. Attempts will be made to avoid the known site below the dam and any other site which might be discovered during construction. Any site which cannot be avoided will be evaluated for salvage or mitigation.

5.06 OPERATION AND MAINTENANCE

a. Structures and appurtenances

(1) Pesticides and herbicides will be used to control a variety of pests which damage structures, interfere with recreational activity, or present a nuisance. These chemicals find their way to water courses and become a source of pollution.

(2) Shoreline erosion is an adverse impact which cannot be avoided, especially in a reservoir with a fluctuating pool. It is difficult for shoreline vegetation to become or remain established because of varying frequency and duration of inundation. Bank protection is expensive and will only be provided where it is cost-effective or required for public health and safety.

b. Recreation development. Adverse environmental impacts will result from increased public use of the facilities provided. However, the operation and maintenance program will be designed to accommodate maximum usage with minimum damage to resources through the application of good management techniques and rehabilitation, as required, of resources both natural and man-made.

5.07 OBJECTIONS RAISED BY OTHERS

a. Texas Committee on Natural Resources, et al. As previously mentioned in Section 1, the Texas Committee on Natural Resources, et al., requested a preliminary injunction against continued work on the project until an environmental impact statement had been filed with the President's Council on Environmental Quality. On 25 May 1971, the Honorable William Wayne Justice, United States District Judge, issued a Writ of Preliminary Injunction restraining and enjoining the Corps of Engineers from further proceeding with the work related to the Cooper Lake and Channels project until such time as the Corps had complied with the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190) by filing a detailed environmental impact statement. The present document is intended to satisfy the requirements of NEPA.

b. Wildlife and fishery agencies

(1) Fish and Wildlife Service letter report dated 13 July 1966. In accordance with provisions of the Fish and Wildlife Coordination Act, the US Fish and Wildlife Service submitted a letter report, dated 13 July 1966, containing their findings and recommendations concerning the authorized Cooper Lake and Channels project (incorporated as part of appendix F on file at the New Orleans District office). This report was generally concurred in by the Arkansas Game and Fish Commission and the Texas Parks and Wildlife Department (letters to the Fish and Wildlife Service, appended to the report in appendix F). The recommendations of the

Fish and Wildlife Service were addressed in Section 4, paragraph c (Remedial, protective, and mitigation measures) of this document.

(2) Fish and Wildlife Service letter report dated 8 March 1972. In a letter dated 14 October 1971, the Corps requested the Fish and Wildlife Service to reevaluate the worth of the stream and adjacent bottomlands for fish and wildlife resources for use in developing the environmental impact statement (appendix F). The Fish and Wildlife Service furnished the requested information in a letter report, dated 8 March 1972 (appendix F). In this letter, the service also indicated that it opposed further channelization of the Sulphur River as authorized because of the substantial losses to the fish and wildlife resources and associated amenities. Most of the impacts described by the service have been included in the EIS; however, the quantified estimates of project induced wildlife and fishery benefits and losses have been updated. In consideration of the opposition to further channelization, the alternative plan, "Reservoir and Levees," is now selected for implementation. This plan includes a small amount of channel realinement, which is required where proposed levees cut off the natural channel. However, in comparison to the draft EIS plan, remaining channelization has been reduced by 80 percent.

(3) Wildlife and Fishery Agencies requests for a third restudy. In a letter dated 27 October 1975, the Texas Parks and Wildlife Department requested that restudy be made to update earlier fish and wildlife reports and establish current impacts of the project on fish and wildlife resources (appendix F). In a letter dated 2 December 1975, the US Fish and Wildlife Service agreed that a restudy should be initiated, indicating that their previous report of 13 July 1966 was inadequate (appendix F). In similar responses to these agencies, dated 14 November 1975 and 13 February 1976 (appendix F), the Corps indicated that to the extent practicable, it would incorporate any additional information provided by these agencies before completion of the final environmental statement. The Corps further emphasized, however, that the environmental statement would contain an objective estimate of project induced impacts on fish and wildlife resources, as determined by its biological consultants and in-house environmental staff.

(4) Fish and Wildlife Service letter report dated 3 September 1976. In a letter report dated 3 September 1976, the US Fish and Wildlife Service (USFWS) recommended the purchase of 42,900 acres of lands within the Sulphur River drainage to compensate for wildlife losses created by the reservoir and downstream flood control features (appendix H). The Texas Parks and Wildlife Department (TPWD) generally concurred with that report, except with

respect to the actual acreage figure for project mitigation (letter appended to the US Fish and Wildlife Report in appendix H). The TPWD noted that an actual acreage figure for mitigation has not yet been determined and is subject to negotiations among the various agencies concerned. Further, they recommended that this matter be clarified in the USFWS letter report. The USFWS request for mitigation will be processed as required by the Fish and Wildlife Coordination Act of 1958. A mitigation report is being developed, with appropriate interagency participation, which will present a mitigation plan. This report will be submitted to the Congress prior to impoundment of water in the reservoir.

SECTION 6--ALTERNATIVES TO THE PROPOSED ACTION

6.01 GENERAL

The present status of the project as authorized by Congress in 1955 includes previously completed levee and channel work upstream of the reservoir (100 percent complete) and levee and channel work below the reservoir (50 percent complete). Although the selected plan now reduces the extensive flood control pilot channel called for in the authorized plan (draft EIS plan), the present environmental condition, which includes the completed channels, is referred to as the status quo (refer to Section 6.04) and is used as the base from which the impacts of the alternatives are assessed.

6.02 STRUCTURAL

Studies were made for both the 15- and 30-year design floods for various structural alternatives. Backwater calculations for the 15- and 30-year floods generally indicated relatively minor differences in land areas subject to inundation. The existing channel capacity is exceeded by floods of low frequency, 2 to 5 years, which spread rapidly over the flood plain. Once the valley floor has been covered by floodwaters, the conveyance of the flood plain increased rapidly with a relatively small increase in stage. Comparisons for providing flood protection for both a 15-year and 30-year design indicated that the added protection afforded by the 30-year design results in nominal incremental increases in cost. Also incremental flood control benefits between the 15- and 30-year degree of protection would be small. These small differences in both benefits and costs for the two degrees of protection tended to result in small changes in the benefit-cost relationship. Since these differences were so small, it was determined that an analysis of the benefit-cost relationship would be made for the 30-year degree of protection only. Consequently, no separate evaluation of benefits and losses for a 15-year design flood is presented. Table VI-1 contains a display of benefits, costs and the corresponding benefit-cost ratio for each of the structural alternatives examined.

a. <u>Alternatives which would accomplish all of the objectives of the proposed action</u>

(1) <u>Reservoir and channel</u>

Table VI-1

Benefit-Cost Analysis Data for Structural Alternatives
(July 1974 Price Level)

Structural Alternatives	First Cost	Annual Cost	Annual Benefit	Benefit-Cost Ratio
SELECTED PLAN	$67,746,000	$3,178,100	$4,727,500	1.5
Reservoir only	$64,324,000	$2,959,100	$4,147,900	1.4
Channel only	45,890,000	1,840,000	3,223,100	1.8
Levees only	5,678,000	311,300	1,500,200	4.8
Reservoir and channel	99,124,000	4,372,500	6,192,300	1.4
Authorized reservoir, levees, and channel (draft EIS plan)	68,737,000	3,236,400	4,706,900	1.5
Channel and levees	6,611,000	366,300	1,453,200	4.0
Reservoir, levees, and channel with landside levee borrow	68,825,000	3,243,000	4,707,300	1.5
Reservoir and levee alinement with channel adjacent to the levees	68,737,000	3,235,400	4,722,200	1.5
Reservoir and channel alinement with levees adjacent to the channel	70,449,000	3,298,400	4,858,200	1.5
Reservoir and levee alinement with clearing and snagging of the river	68,472,000	3,227,400	4,726,200	1.5
Reservoir and levee alinement with clearing and snagging plus major bend cutoffs	68,533,000	3,229,600	4,713,600	1.5

Table VI-1 (Cont'd)

Structural Alternatives	First Cost	Annual Cost	Annual Benefit	Benefit-Cost Ratio
Reservoir and levee alinement with selected major bend cutoffs	$67,944,000	$3,202,400	$4,758,800	1.5
Reservoir, levees, and channel - channel bottom raised 5 feet	68,017,000	3,211,600	4,713,900	1.5
Reservoir and selective flood proofing by ring levees	67,282,000	3,160,100	4,773,900	1.5
Reservoir with animal refuge mounds	64,429,000	2,963,100	4,138,200	1.4
Reservoir and nonrestrictive easement	71,692,000	3,458,100	3,410,000	0.9
Reservoir and restrictive easement	75,768,000	3,696,100	3,410,800	0.9
Reservoir and fee purchase	82,242,000	4,151,100	3,508,200	0.8

(a) Project description (refer to plate VI-1)

1. Reservoir. The reservoir in this plan follows the specifications of the reservoir discussed in detail under the selected plan (Section 1).

2. Channel

a. Specifications. The realined channel would begin at the service spillway outflow channel near the existing South Sulphur River, approximately Station 150+00 and end at Station 3122+00 about 1,500 feet upstream of State Highway No. 26 (US Highway No. 259) on the Sulphur River. Beginning at the outfall of the service spillway outlet channel near the South Sulphur River, a realined channel with a 25-foot bottom width, 1 on 1 side slopes, and bottom grade of .0007 feet per foot, would be excavated for a length of approximately 2 miles to State Highway No. 154, channel station 245+00. The 30-year flood would require a 100-foot bottom width channel from State Highway No. 154 to Station 587+00. The existing enlarged channel would be adequate for a length of 74,300 feet to Station 1330+00. At this point, the 90-foot bottom width at station 1330+00 would transition to 750 feet just below State Highway No. 37. From below State Highway No. 37 at Station 1519+50, the channel would remain 750 feet wide for a length of 160,250 feet, and slope .00046 feet per foot to the headwaters of Wright Patman Lake at Station 3122+00, where the channel would transition to the natural channel upstream of State Highway 26 (US Highway 259). The channel clearing for the realined channel would extend 50 feet beyond the top of excavated channel slopes to the toe of uncompacted disposal areas on either side of the channel. No clearing would be performed in the disposal area. Gaps would be provided in the length of the embankment of dredged material to avoid blockage of natural drainage to the channel. An allowance of 20 percent in the embankment length was made for this purpose. The 30-year channel floodway would require 4,300 acres of clearing. Right-of-way would extend 5 feet beyond the outside slopes of the disposal areas. The embankments of dredged material would have a minimum 1 on 3 side slopes with a variable top width depending upon excavation in a particular river reach in order to minimize handling. An optimum embankment height of 10 feet was used to estimate width requirements. Total required right-of-way for the channel is 10,600 acres for the 30-year design.

b. Relocations. There is one county road bridge, four underground pipelines, and several electric power lines and communication lines that must be relocated or modified in connection with the improvements proposed. Relocations for channel work are as follows:

	Location	Type	Stream
1.	Titus Co.-Sulphur River crossing 6 miles south of Cuthand, Texas	Road and bridge	Sulphur
2.	Station 1664+80	Pipeline (8" gas)	Sulphur
3.	Station 1696+60	Electric	Sulphur
4.	Station 1795+10	Telephone	Sulphur
5.	Station 1798+20	Telephone	Sulphur
6.	Station 2677+00	Pipeline (24" oil)	Sulphur
7.	Near State Highway 271	Aqueduct to Talco	Sulphur

(b) Probable impacts

1. Beneficial. In addition to the benefits of water supply and recreational potential to be derived from the reservoir (see Section 4.02), this alternative would provide flood protection for 28,000 acres of bottomland hardwoods and 21,200 (6,600 semiwooded and 14,600 cleared) acres of agricultural lands. As a consequence of the realinement of the natural river, a total of 283 acres of oxbow cutoffs would be formed (table IV-3). The potential benefits expected from the oxbows include 9,409 man-days of consumptive recreation and 9,905 pounds of commercial fish, having a combined annual value of nearly $16,000. The right-of-way area used for disposal of dredged material from channel construction would provide considerable habitat for various wildlife species during the successional process. Substantial favorable impacts are expected by employing local labor for construction and maintenance of the reservoir and channel. This alternative would allow for the conversion of current flood plain to pastures, with a net increase in grazing lands.

2. Adverse. In addition to the general adverse impacts of the reservoir and channel, described in Section 4.02, many of the wildlife and fishery resource losses can be quantified. This alternative would promote the loss of 21 miles of natural river from inundation by the lake and 83 miles from channelization (table IV-4). This amounts to 614 surface acres of fishable water which supports a potential sport fishery of 12,280 man-days, having an annual value of $18,420, and the potential for an annual harvest of 30,700 pounds of commercial fish valued at $4,605. An estimated $13,806 in annual fur harvest would be lost with the implementation of this alternative. Wildlife recreation losses were computed for an anticipated loss of 38,350 acres of bottomland

hardwoods (8,600 acres for the channel, 7,350 acres for the reservoir, and 22,400 acres from induced clearing) and 24,975 acres of agricultural lands (2,000 acres for the channel, 16,375 acres for the reservoir, and 6,600 acres of semiwooded area which is expected to undergo further clearing due to increased flood protection) (table IV-5). Accordingly, project induced wildlife recreation losses totaled 37,246 man-days valued at $88,652, annually. Although considerable air and noise pollution is expected during construction, the area is sparsely inhabited, thus the adverse social impacts would be minimized. In addition to those sites affected by the reservoir, channelization could partially impact the southern edge of archeological site RR 28 near Talco, Texas, (appendix D); however, care will be taken to avoid this site. No other known cultural resources would be affected.

(2) Authorized reservoir, levees, and channel (draft EIS plan)

(a) Project description (refer to plate VI-2)

1. Reservoir and levees. The reservoir and levee alinement of this plan follow the specifications of the selected plan (Section 1). Approximately 21 miles of levee (levees 3RS and 4RS) would be about 1½ feet less in height than those levees of the selected plan. This is attributable to the fact that the authorized plan includes a continuous pilot channel and overbank clearing which would effectively lower flood stages in this area.

2. Channel

a. Downstream from dam. A total of approximately 35 miles of additional realined channel are required below Cooper dam. The channel improvement would begin at the point where the service spillway outlet channel of the dam discharges into the South Sulphur River and would continue downstream to channel station 3122+00 on the Sulphur River. The only work that would be required to station 168+40 on the South Sulphur River is floodway clearing. The clearing would be limited to 75 feet each side of present channel centerline to provide a 150-foot-wide cleared floodway. At channel station 168+40 on the South Sulphur River a realined channel would be excavated to a 12-foot bottom width with 1 on 1 side slopes and a .0007 channel bottom grade to channel station 587+00. From channel station 587+00 to station 1519+50 the existing channel has enlarged and no additional excavation is planned for this 17.66-mile reach. The 150-foot floodway clearing would be continued through this reach even though no additional channel excavation is proposed. From channel station

1519+50, which is about 1.5 miles below State Highway No. 37, the channel excavation and realinement would continue on a .00046 channel bottom grade for approximately 30 miles to channel station 3122+00, slightly above State Highway No. 26 (US Highway No. 259). A reach of the Sulphur River has already been cleared for the realined channel for a length of about 46,000 feet upstream from the confluence of Cuthand Creek and the Sulphur River. In addition, approximately 16,000 feet of the required 12-foot bottom width channel has been excavated within the upper reaches of the cleared area. This work was completed in 1971 along with floodway clearing. Excavated material resulting from channel work not utilized for plugging of the old channel would be disposed of by casting in uncompacted disposal areas. Openings would be left in the disposal areas as required to provide for natural drainage. A minimum berm of 50 feet would be left between the top edge of the excavated channel and the riverside toe of the disposal area in order that future enlargement of the channel would not remove the disposal area. The embankments of dredged material would be limited in height to about 10 feet. Earth plugs would be placed across the existing channel to help confine low river flows to the new channel, thereby encouraging enlargement and self-maintenance of the planned channel. Floodway clearing and right-of-way would extend 75 feet on each side of the centerline of the channel for a total width of 150 feet, and total channel work is estimated to require about 900 acres.

b. Upstream from dam. All channelization upstream from Cooper dam has been completed. The total length of completed upstream channels is about 18 miles.

c. Relocations. There is one county road bridge, three underground pipelines, and several electric power and communication lines that must be relocated or altered in connection with the channel improvements as proposed. A tabulation of alterations and relocation work required is as follows:

Location	Type	Stream
Titus Co.-Sulphur R. (Crossing 6 miles south of Cuthand)	Road Bridge	Sulphur
Channel Station 1664+80	Pipeline (8" gas)	Sulphur
Channel Station 1696+60	Electric Line	Sulphur
Channel Station 1795+10	Telephone Line	Sulphur
Channel Station 1798+20	Telephone Line	Sulphur
Channel Station 2677+00	Pipeline (24" oil)	Sulphur
Near State Highway No. 271	Aqueduct to Talco	Sulphur

(b) Probable impacts

1. Beneficial. Refer to Section 4.02 for a thorough discussion of the general impacts of a reservoir, levees, and channel. This alternative will provide flood protection for 11,600 acres of bottomland hardwoods and 12,100 (3,200 semiwooded and 8,900 cleared) acres of agricultural lands. The excavation of new channels would result in the formation of 49 miles (353 acres) of oxbow cutoffs which would contribute 11,737 man-days of consumptive recreation and 12,355 pounds of commercial fish, having a combined annual value of nearly $20,000 (table IV-3).

2. Adverse. This alternative would result in the loss of 21 miles of natural river due to inundation of the reservoir and 78 miles due to channel realinement (table IV-4). These 99 miles of natural river support a potential sport fishery of 11,500 man-days and a potential annual harvest of 28,750 pounds of commercial fish, with a total (combined) annual value of $21,563. Implementation of this plan would result in the loss of a potential fur harvest having an estimated value of $6,419. Calculations of wildlife recreation losses are based on the anticipated loss of 17,830 acres of bottomland hardwoods (1,200 acres for the levees and channel, 7,350 acres for the reservoir, and 9,280 acres from induced clearing) and 19,875 acres of agricultural lands (300 acres for the levees and channel, 16,375 acres for the reservoir, and 3,200 acres of semiwooded area which will be further cleared) (table IV-5). Based on these acreages, project induced wildlife recreation losses would be 18,336 man-days valued at $43,402, annually. In addition to those archeological sites affected by the reservoir (discussed under the recommended plan in Section 4), a new levee near river mile 152 could possibly affect site TT 40. Disposal areas resulting from channel construction could affect site RR 28, a seasonal type Indian settlement of Archaic times. However, steps would be taken to avoid these or any other sites which might be discovered during construction. No other known cultural resources would be affected.

(3) Reservoir, levees, and channel with landside levee borrow

(a) Project description (refer to plate VI-3). This plan follows the specifications of the authorized plan except that the levee borrow material is taken from the landside of the levees instead of the flood side. The right-of-way would be greater for this project than the authorized plan since additional land must be acquired as borrow area.

(b) Probable impacts

1. Beneficial. The general beneficial impacts, as well as the specific wildlife and fishery benefits expected from the formation of oxbows (table IV-3) would be identical to the draft EIS plan since the channel alinement and length do not vary from that plan.

2. Adverse. The only variation from the authorized plan is directly correlated to the amount of habitat specifically influenced by this project. The larger acreage figures in this plan are due to the use of landside levee borrow rather than borrow from the flood side, where destruction from clearing would have already occurred. There would be an anticipated loss of consumptive recreation from 18,070 acres of bottomland hardwoods (1,600 acres for the levees and channel, 7,350 acres for the reservoir, and 9,120 acres from induced clearing) and 19,975 acres of agricultural lands (400 acres for the levees and channel, 16,375 acres for the reservoir, and 3,200 acres of semi-wooded area subject to further clearing) (table IV-5). The net increase in the loss of wildlife habitat, over the draft EIS plan, is 340 acres. Based on the loss of wildlife habitat, project induced wildlife recreation losses for this plan total 18,564 man-days, with an annual value of $43,946 (table IV-4). In addition, an estimated $6,505 in annual fur harvest would be lost with the implementation of this alternative.

(4) Reservoir and levee alinement with channel adjacent to the levees

(a) Project description (refer to plate VI-4)

1. Reservoir and levees. The reservoir and levee alinement of this plan follows the specifications of the selected plan (Section 1).

2. Channel. The channel alinement in this plan is adjacent to the levees. Implementation would involve the excavation of a 12-foot bottom width channel with the resultant material used for levee fill. A 1 on 10 slope for borrow excavation would have to be maintained from the toe of the levees to the bottom of the excavated channel. This would result in a channel too far from the levees for material to be excavated and cast in place with ordinary construction draglines. Thus, the material would have to be cast in place with draglines, then spread and compacted with dozers. Any materials which have to be obtained

from sources more distant from the immediate area, and which cannot be placed by this technique, would be hauled by truck to the site for placement. In addition, borrow pits would be established on the flood side to obtain the maximum amount of borrow possible before resorting to the use of enlarged landside ditches for borrow material. Earth plugs would be placed across the riverside borrow pit at approximately ¼ mile intervals to reduce channel velocities which could cause further enlargement of the borrow pit and eventual erosion of the levee.

(b) Probable impacts

1. Beneficial. The length of the channel in this alternative is the same as in the draft EIS plan. The channel alinement of this plan, however, more closely follows the natural Sulphur River and, accordingly, fewer oxbow cutoffs would be formed. This channel alinement would result in the formation of 252 acres of oxbows with a potential for furnishing 8,378 man-days of consumptive recreation and 8,820 pounds of commercial fish having a combined annual value of $14,169 (table IV-3).

2. Adverse. Refer to the draft EIS plan for a complete discussion of adverse impacts. In addition to the archeological sites affected by the reservoir, the levees and channel of this alternative could impact upon sites TT 40 and RR 28; however, efforts will be made to avoid these sites. No other known cultural resources will be affected.

(5) Reservoir and channel alinement with levees adjacent to the channel

(a) Project description (refer to plate VI-5)

1. Reservoir and channel. The reservoir and channel alinement of this plan follows the specifications of the draft EIS plan.

2. Levees. The levees in this plan would be constructed adjacent to the channel, with channel excavation being used as levee borrow material. Rights-of-way would not be reduced since the channel and levee rights-of-way are established at a width of 150 feet of permanent easement for the channel and 100 feet each side of centerline for each levee. The construction of the levee adjacent to the channel is controlled by the safety requirement of a slope of 1 on 10 from toe of levee slope to bottom

of channel grade. In addition, higher levees would be required due to the reduced floodway width.

(b) Probable impacts

1. Beneficial. Beneficial impacts of this alternative are identical to those discussed under the draft EIS plan.

2. Adverse. This alternative differs from the authorized plan in that an additional 2,000 acres of bottomland hardwoods would be protected from flooding with this plan. Since this area would likely be subjected to clearing for agricultural purposes, wildlife resource losses would be greater for this plan. This alternative would produce an anticipated loss of consumptive recreation from 19,830 acres of bottomland hardwoods (1,200 acres for the levees and channel, 7,350 acres for the reservoir, and 11,280 acres from induced clearing) and 19,875 acres of agricultural lands (300 acres for the levees and channel, 16,375 acres for the reservoir, and 3,200 acres of semiwooded area which is expected to undergo further clearing due to increased flood protection) (table IV-5). These habitat losses result in a reduction in potential for 20,100 man-days of wildlife recreation valued at $47,654, annually. Implementation of this alternative would, in addition, result in the loss of potential fur harvest having an estimated value of $7,139. Channel alinement will affect one archeological site, RR 28 (appendix D which is now on file at the New Orleans District). The levee alinement in this plan will not disturb any other known cultural resource.

(6) Reservoir and levee alinement with clearing and snagging of the river

(a) Project description (refer to plate VI-6). The reservoir with the levee alinement as presented for the selected plan (Section 1), but with clearing and snagging of the existing river is proposed for this plan. This plan would initially increase channel capacity by removing obstructions and increasing velocity of flows; however, the channel would ultimately revert to its original state of overgrowth without continuous maintenance. In this alternative the alinement of the levees will require a certain amount of new channel excavation since there are several locations where the levees would cut off the natural channel. The length of these channels would be the same as in the selected plan; however, the associated levees in this alternative would be of slightly lower height since the clearing and snagging would allow a more

rapid runoff with a lower crest. On the other hand, the right-of-way required for this additional feature of clearing and snagging would be slightly greater than for the selected plan.

(b) Probable impacts

1. Beneficial. The increase in channel capacity would be only a small percentage of the total flood discharge and, therefore, during major flood flows the clearing and snagging work would be no more beneficial than the selected plan.

2. Adverse. The general impacts of this plan are essentially the same as those presented for the recommended plan (Section 4). The additional loss of terrestrial habitat to construction features would have an adverse effect on the recreation potential of the area. Wildlife recreation losses were computed for anticipated losses of 18,790 acres of bottomland hardwoods (2,000 acres for the levees, some limited channelization, and snagging; 7,350 acres for the reservoir; and 9,440 acres from induced clearing) and 20,075 acres of agricultural lands (500 acres for the levees and some limited channelization, 16,375 acres for the reservoir, and 3,200 acres of semiwooded area which would be further cleared) (table IV-5). Project induced wildlife recreation losses would be 19,215 man-days valued at $45,508, annually (table IV-4). An estimated $6,764 in annual fur harvest would be lost with the implementation of this alternative. In addition to those archeological sites to be affected by the selected plan, clearing and snagging could affect two documented sites. These are Site RR 28, previously described in Section 4, and Site TT 45, located about river mile 142 on the Sulphur River. The latter site is a seasonal type camp of Archaic culture and is located on a terrace extending almost to the riverbank. An attempt would be made to avoid these or any other sites encountered during construction. No other known cultural resource would be affected.

(7) Reservoir and levee alinement with clearing and snagging plus selected major bend cutoffs

(a) Project description (refer to plate VI-7). The reservoir and the levee alinement of the selected plan (Section 1) were combined with clearing and snagging of the existing river and excavation of cutoffs at selected major bends of the river, in lieu of a complete channel excavation.

(b) Probable impacts

1. Beneficial. The plan would temporarily increase the channel capacity and velocity. Without continuous maintenance of the cleared and snagged channel it could revert to its natural state of overgrowth. Enlargement by erosion due to removal of ground cover would not necessarily follow a uniform straightening pattern such as would be accomplished by continuous excavated channel realinement. Excavation of selected major cutoffs in the existing river would be effective, at least temporarily, in reduced water surface profiles not only through the cutoff section but also slightly upstream and downstream of the cutoffs. However, these cutoffs are generally short so that the resultant increase in capacity would be somewhat diminished by the overlap of water stage transition curves. The result is a maximum theoretical water stage drop through only a relatively short length of an already short cutoff reach of the river. This water stage drop is beneficial at the limited reach of the cutoff but at the expense of increased flood stage downstream of the cutoff due to loss of valley flood storage that would have been obtained had the cutoff not been excavated. General biological and sociological impacts for this plan are the same as those for the selected plan (Section 4). The amount of channeling on the Sulphur River would be somewhat greater than with the selected plan. Five major bendways would be cut off creating 5 miles of oxbows on the South Sulphur River and 22 miles of oxbows on the Sulphur River (table IV-3). These oxbows would contribute 6,051 man-days of consumptive recreation and 6,370 pounds of commercial fish, annually, having a total combined value of $10,235.

2. Adverse. Construction features of this plan would result in the loss of 49 miles (231 surface acres) of natural river which support a potential sport fishery of 4,620 man-days and a potential annual harvest of 11,550 pounds of commercial fish, with a total combined annual value of $8,663 (table IV-4). Calculations of wildlife recreation losses are based on the anticipated loss of 18,410 acres of bottomland hardwoods (1,700 acres for the levees, clearing and snagging, and limited channelization; 7,350 acres for the reservoir; and 9,360 acres from induced clearing) and 19,975 acres of agricultural lands (400 acres for the levees, clearing and snagging, and limited channelization; 16,375 acres for the reservoir; and 3,200 acres of semiwooded area which will be further cleared) (table IV-5). Based on these acreages, wildlife recreation losses would be 18,863 man-days valued at $44,663, annually. In addition, implementation of this plan would result in the loss of a potential fur harvest having an estimated

value of $6,628. Impacts on archeological resources are the same as those resulting from the "Reservoir and Levee Alinement with Clearing and Snagging of the River" alternative, since there are no impacts on archeological sites resulting from the major bend cutoffs.

(8) Reservoir and levee alinement with selected major bend cutoffs

(a) Project description (refer to plate VI-8). This plan is similar to the "Reservoir and Levee Alinement with Clearing and Snagging Plus Major Bend Cutoffs" alternative, except that this plan does not require clearing and snagging of the existing river.

(b) Probable impacts

1. Beneficial. As noted in Section 4, the reservoir does not significantly reduce flood discharges below the confluence of the North and South Sulphur Rivers, and the existing river channel will not contain these flood discharges. The higher the flood stage, the less effect the initial channel cutoffs would have on this stage at any reach of the river since the channel cross-sectional area is small compared with the flood plain area. There would be no more significant benefit from this plan than with the selected plan. If floods were retained by the new channel cutoff, any benefits would be greatly reduced by increased flooding downstream of the cutoff from flows formerly stored in the flood plain upstream. Also, the duration of the flood crest would be reduced. If stretches between cutoffs are not improved to increase channel capacity and uniformity of flow, elimination of sharp bends in a channel is of little value, except locally, for discharges up to full bank capacity in the cutoff stretch.

2. Adverse. Fishery benefits and losses would be the same as those presented in the previous alternative, since only the clearing and snagging are omitted in this plan (tables IV-3 and IV-4). Wildlife recreation losses were based on the anticipated loss of 17,590 acres of bottomland hardwoods (800 acres for the levees and major bend channelization, 7,350 acres for the reservoir, and 9,440 acres from induced clearing) and 19,775 acres of agricultural lands (200 acres for the levees and major bend channelization, 16,375 acres for the reservoir, and 3,200 acres of semiwooded area which would be further cleared) (table IV-5). The wildlife recreation losses amount to 18,109 man-days, worth $42,864, annually. An estimated $6,332 in annual fur harvest

would be lost with the implementation of this alternative. Adverse effects to archeological resources would be the same as those presented for the selected plan. The major bend cutoffs would not affect any known cultural resources.

(9) Reservoir, levees, and channel - channel bottom raised 5 feet

(a) Project description (refer to plate VI-9). This plan is identical to the authorized reservoir, levees, and channel plan, except that the channel bottoms are excavated 5 feet less in depth.

(b) Probable impacts

1. Beneficial. Generally, the beneficial impacts are identical to those discussed in the impacts section (Section 4) for the recommended plan.

2. Adverse. This alternative differs from the draft EIS plan only in the total acres of bottomland hardwoods which are considered to be lost either directly or indirectly to project features. These differences produce only a slight variation in wildlife recreation losses between this alternative and the authorized plan. Wildlife recreation losses for this alternative were computed for an anticipated loss of 17,910 acres of bottomland hardwoods (1,200 acres for the levees and channel, 7,350 acres for the reservoir, and 9,360 acres from induced clearing) and 19,875 acres of agricultural lands (300 acres for the levees and channel, 16,375 acres for the reservoir, and 3,200 acres from induced clearing) (table IV-5). Accordingly, project induced wildlife recreation losses totaled 18,406 man-days, with a value of $43,570. In addition, implementation of this plan would result in the loss of a potential fur harvest having an estimated value of $6,448. No known cultural resources would be affected.

b. Alternatives which might only provide a partial solution to all or part of the objectives

(1) Reservoir only

(a) Project description (refer to plate VI-10). The reservoir in this plan follows the specifications of the reservoir discussed in detail under the selected plan (Section 1).

(b) Probable impacts

1. Beneficial. Impacts are identical to those presented for the reservoir feature of the selected plan in Section 4.

2. Adverse. Impacts are identical to those presented for the reservoir feature of the selected plan in Section 4.

(2) Reservoir and selective flood proofing by ring levees

(a) Project description (refer to plate VI-11). This plan combines the reservoir with selective flood proofing of areas downstream from Cuthand Creek. Flood proofing would be accomplished by construction of seven ring levees at isolated areas where protection from serious flooding was considered desirable. These ring levees would be located so as to maximize the area protected and cause a minimum backwater effect due to the construction. Due to the backwater effect caused by the ring levees, the existing levee, 5LC, on the left bank of Cuthand Creek would require some modification. Pertinent data on the proposed plan of ring levees is shown in the following tabulation:

Ring Levee Improvements

Levee	Culverts Required	Drainage Area (Acres)	Length of Levee (Linear Feet)	Volume (Cubic Yards)
2LS	3-60"	4,640	32,900	992,800
3LS	2-60"	2,180	25,900	1,084,000
5RS	2-60"	2,050	23,500	1,128,500
6RS	2-54"	895	5,200	212,300
7RS	2-54"	895	5,500	182,200
8RS	1-60"	400	4,300	128,600
9RS	1-60"	400	2,300	63,200
5LC	-	-	8,000	250,000

Levee 2LS would be located just downstream of the confluence of the realined Cuthand Creek and the Sulphur River. Beginning approximately 4,000 feet downstream of the intersection of Shawnee Creek

and the old Cuthand Creek channel, the levee would run southward crossing the Sulphur River; then northeasterly to high ground, encircling Hardison Lake. Where the present Sulphur River would be cut off by the levee, a new 12-foot bottom width channel would be excavated for an approximate length of 8,000 feet. Levee 3LS would be located from the mouth of Cedar Creek to approximately 12,000 feet upstream, cutting off about 6 miles of the Sulphur River. A new 12-foot channel would be excavated for a length of approximately 12,000 feet. Levee 5RS begins on the right side of the Sulphur River opposite the end of Levee 2LS. The levee extends from high ground northeasterly across Long Lake Slough; then southeasterly parallel to the slough about 16,000 feet. Making a gradual right turn to the south, the levee would then cross the slough again and turn westward connecting to high ground. The levee would encircle Blue Lake. Levee 6RS would start opposite the end of Levee 3LS at Long Lake Slough and cross the Sulphur River in an easterly direction, gradually turning southeast to a mound which has a peak slightly below the elevation required for the levee. Levees 6RS and 7RS connect at this mound. Levee 7RS continues southeasterly crossing the river once again and intersects high ground. Levee 8RS continues southeasterly on the downstream side of the same hill intersected by Levee 7RS and connects to another hill about 4,300 feet downstream. Levee 9RS commences on the slough side of the hill intersected by Levee 8RS at its downstream end, and runs southward 2,300 feet to high ground just above State Highway No. 26. All of the ring levees would be designed on the basis of a 1-foot freeboard above the 30-year design water surface profile. The same levee section and embankment design criteria would be used as that of the levee as described in the alternative plan of "Levees Only."

(b) Probable impacts

1. Beneficial. The beneficial impacts are generally described under the selected plan. This alternative would provide flood protection for 10,400 acres of bottomland hardwoods and 9,800 (1,500 semiwooded and 8,300 cleared) acres of agricultural lands, which is less flood protection than that provided by the selected plan. Where proposed levees cut off the natural channel, the excavation of new channels would be required. This channelization would result in the formation of 17 miles (133 acres) of oxbow cutoffs along the Sulphur River. These oxbow lakes would contribute 4,422 man-days of consumptive recreation and 4,655 pounds of commercial fish, annually, having a combined value of $7,480 (table IV-3).

2. Adverse. In this plan, only the 21 miles of the South Sulphur River that would be permanently inundated by the reservoir would be lost; no additional channelization of the South Sulphur would occur. Channelization along the Sulphur River would result in the loss of an additional 15 miles of natural river. These losses of fishable stream would eliminate 3,180 man-days of potential sport fishing and a potential harvest of 7,950 pounds of commercial fish, with a total combined annual value of $5,963 (table IV-3). Calculations of wildlife recreation losses were based on the anticipated loss of 16,170 acres of bottomland hardwoods (500 acres for the levees and limited channelization, 7,350 acres for the reservoir, and 8,320 acres from induced clearing) and 17,975 acres of agricultural lands (100 acres for the levees and limited channelization, 16,375 acres for the reservoir, and 1,500 acres of semiwooded area which will be further cleared) (table IV-5). Based on these acreages, project induced wildlife recreation losses would total 16,570 man-days with an annual value of $39,269 (table IV-4). Implementation of this plan would result in the loss of a potential fur harvest having an estimated value of $5,821. No archeological sites, other than those inundated by the reservoir, would be affected by the ring levees. No other known cultural resources would be affected.

(3) Reservoir with animal refuge mounds

(a) Project description (refer to plate VI-12). Animal refuge mounds located at 1-mile intervals along the flood plain in conjunction with the recommended reservoir would provide high ground to animals within reasonable distance to any point in the flood plain below the dam. The following criteria were used in designing the animal refuge mounds:

1. 1 on 4 side slopes.

2. Construction or refuge mounds 3 feet above design water surface elevations.

3. Surface area of each mound - approximately 0.1 acre.

4. Construction would be truncated cones rather than rectangular or square mounds, as volume would be smaller for the same top area, and flow of floodwaters around a curved surface would cause less erosion than flow around square corners and against a flat surface.

5. Diameter at top of mound equals approximately 75 feet.

6. If the centerline of the flood plain is within ½ mile of high ground (above floodwater surface), no mound would be constructed.

7. Compaction of mound fill would be, as a minimum, equal to compaction used for existing levees.

8. Existing levees would serve as refuge mounds, and protect lands behind levees, requiring no mounds.

(b) Probable impacts

1. Beneficial. Since the reservoir in this plan follows the specifications of the selected reservoir, the impacts of the reservoir feature of this alternative would be identical to those discussed in Section 4. With the current decline of the economic situation, the potential use of the flood plain for cattle raising in the future is ever present. It is likely that the animal refuge mounds would be of some benefit in saving livestock from drowning during flood conditions. No benefits to wildlife populations, however, are expected from the refuge mounds.

2. Adverse. Impacts are identical to those presented in Section 4 for the reservoir feature of the selected plan. No further adverse effects to archeological or other cultural resources are expected from construction of the animal refuge mounds.

(4) Reservoir and nonrestrictive easement

(a) Project description. A nonrestrictive flood damage easement combined with the reservoir feature of the selected plan would allow the people to continue living, farming, and developing their land within the flood plain of the Sulphur River as normally would be expected under existing conditions and trends. This type of easement would average approximately 50 percent of the cost of the fee value of the land. This amount would be paid to individual landowners, and they, in turn, would absorb any damages to their life, health, and property. Individual landowners presently absorb these damages plus levee repair costs, except for certain levees, which, when properly maintained, are protected by Federal flood insurance programs. This alternative plan would not provide

any additional flood prevention benefits beyond that attributed to the reservoir. In essence, this alternative plan would be expected to change only the fiscal responsibility for flood losses.

(b) Probable impacts

1. Beneficial. Impacts are the same as those discussed in Section 4 for the reservoir feature of the selected plan.

2. Adverse. This plan would encourage opposite reaction to the desired objective of preventing flood damage by controlling construction, living, and placing of damageable items within the flood plain area. Environmental damages would consist of a combination of the measurable adverse impacts from the reservoir (discussed in Section 4), plus unquantifiable damages from continued clearing by local interests. Damage produced by the latter is speculative, but present trends indicate that land reclamation will continue, although at a much slower rate than with implementation of a structural alternative.

(5) Reservoir and restrictive easement

(a) Project description. Restrictive flood easement acquisition combined with the reservoir would involve the purchase and removal of all flood damageable property within the Sulphur River flood plain, downstream from the dam, and restriction of future use and development of the area including advanced agricultural development. People presently living within the flood plain area would be required to move. Structural improvements would not be permitted in the area. The cost of acquiring restrictive flood easements to prevent compensable flood damages on all land within the Sulphur River flood plain area under study would be about 75 percent of fee value.

(b) Probable impacts

1. Beneficial. The reservoir offers limited relief from floods, a water supply, and public land and water for recreation (as discussed in Section 4). Since this alternative would require the removal of all flood damageable property within the flood plain and would restrict future use and development (including agriculture), it will preserve the status quo. The area subject to flood damage includes 48,000 acres of bottomland hardwoods and 15,000 acres of semiwooded and cleared lands. Although this would eliminate further damage to wildlife and fishery populations, no increased recreation benefits are attributed to this plan

since the status quo conditions would not enhance carrying capacities. The restrictions in this type of easement would preclude the establishment of wildlife and fishery management areas.

2. Adverse. Refer to Section 4 for a discussion of the impacts which attend the reservoir feature of this alternative. The restrictive flood easement plan would relinquish the flood control benefits which attend many of the other alternatives. It would curtail the current agricultural activities in a major portion of the Sulphur River flood plain and, thereby, reduce land utilization, production, and income. Further, the limited land use permitted would seriously infringe upon the normal rights of ownership to such a degree as to adversely affect the marketability and sale of involved properties. Only the archeological resources within the reservoir would be affected. No other known cultural resource would be affected.

(6) Reservoir and fee purchase

(a) Project description. This plan involves a combination of the recommended reservoir with acquisition of the flood plain in fee simple, in lieu of an easement. The acquired lands would be fallow, reverting to a wild state, and open to the public for hunting or other recreational use.

(b) Probable impacts

1. Beneficial. Refer to Section 4 for a general discussion of impacts associated with the reservoir. Fee acquisition of the flood plain would be the most beneficial alternative to wildlife populations, since it would allow intense management on 63,000 acres of periodically inundated flood plain. In calculating the potential wildlife increases from flood plain acquisition, it was estimated that intense management would double the potential hunting and wildlife-oriented recreation presently available in the basin. Table VI-2 presents this increase in recreation potential on the basis of presently available flood plain. Establishment of the reservoir would further increase recreational benefits; however, certain losses would attend its construction (see section 4).

2. Adverse. Present use of flood plain lands, even with occasional flooding, presumably produces a profit for their private owners, or else such use would not continue. Any alternative plan for flood control accomplished by fee simple purchase of the Sulphur River flood plain would not prevent the actual

flooding but would prevent damages. The taking of lands from agricultural production does constitute an adverse indirect impact of this alternative. This alternative recognizes modern water resource development practices as a means to create and maintain conditions under which man and nature can exist in productive harmony. This alternative, however, will not fulfill the social and economic requirements of present and future generations living in the Lower Sulphur River Basin and contiguous areas. The same archeological sites affected by the reservoir in the selected plan (Section 4) would be affected in this plan. No other known cultural resource would be affected.

Table VI-2

Potential Wildlife Recreation Benefits from Fee Purchase of the Flood Plain

Wildlife Recreation Category	Gains	Value
Big game hunting	5,424 man-days[1]	$32,544[2]
Small game hunting	13,377 man-days[3]	26,545[4]
Waterfowl hunting	384 man-days[1]	2,304[5]
Wildlife-oriented recreation	24,000 man-days[1]	36,000[6]

[1]Based on purchase and management of 48,000 acres of bottomland hardwoods.

[2]$6.00/man-day - value of big game hunting.

[3]Based on purchase and management of 48,000 acres of bottomland hardwoods and 15,000 acres of agricultural lands.

[4]$2.00/man-day - value of small game hunting.

[5]$6.00/man-day - value of waterfowl hunting.

[6]$1.50/man-day - value of wildlife-oriented recreation.

(7) Channel only

(a) Project description (refer to plate VI-13)

1. Completed works. In the reach of the river near the confluence of the North and South Sulphur River, existing levees would be used to minimize channel excavation and to retain floodwaters within the levees. Existing levees could not be used in other reaches of the river since they are breached and ineffective due to past flooding and lack of maintenance. Therefore, in these reaches of the river the channel was designed to

retain the flood entirely within the banks of the channel. The channel on South Sulphur River from State Highway No. 24 to approximately 7,000 feet downstream of F.M. No. 71 was realined many years ago and has since enlarged to an approximate width of 120 feet and to an average depth of 20 feet. Channel capacity is sufficient to handle the 30-year flood discharge and no additional work is required in this reach.

2. Additional work. From the end of the existing realined channel station -563+00, the 30-year flood channel would transition to a bottom width of 450 feet. The channel would be excavated to 1 on 1 side slopes with excavation disposed of by casting on either side of the channel. The disposal areas would be uncompacted with 1 on 3 side slopes and a top width as required in each particular reach of the river to minimize hauling or handling. This top width was calculated using a optimum 10-foot height of embankment. The edge of the disposal area slopes would be set a minimum of 50 feet from the top of the excavated channel slopes. This distance also represents the limit of channel clearing required. Depending upon depth of channel and disposal requirements in a particular reach of the river, the clearing limits and rights-of-way would vary. This would require a maximum channel clearing limit of 590 feet and a maximum right-of-way of 1,340 feet for the 30-year flood channel. The 450-foot-wide channel for the 30-year flood would continue in length for a distance of 56,300 feet (10.6 miles) to river mile 23.2 or channel station 100+00, on the South Sulphur River. The 30-year flood 450-foot bottom width channel commencing upstream of river mile 23.2, would transition to 400 feet at Station 100+00. A 400-foot-bottom width channel would then be required from station 100+00 to station 72+00, the channel would transition to 150 feet and continue at this width for a length of 30,000 feet (5.6 miles) to station 1023+00 and then transition to the existing channel which is adequate with existing levees to retain the 30-year flood. The existing channel extends 30,700 feet (5.7 miles) to station 1330+00. From channel station 1330+00 to station 1519+50 a transition is required from 1,200 feet wide at station 1330+00 to 800 feet wide at station 1519+50. This allows the water surface profile to drop from the levee retention level to within the channel banks where no existing levee protection is provided. The channel would remain 800 feet wide from station 1519+50 to station 3122+00, the headwaters of Wright Patman Lake just above State Highway No. 26. This channel would retain the flood entirely within the channel banks. Clearing limits for the 800-foot-bottom width channels would be set 50 feet landward from the top of excavated channel slopes. The maximum clearing limits would be 940 feet. Uncompacted disposal areas would be

raised to a maximum height of 10 feet using 1 on 3 side slopes from the clearing limits on either side of the channel. The disposal area top widths would vary as required to minimize handling. Gaps would be provided in the length of the disposal area to avoid blockage of natural drainage to the channel. An allowance of 20 percent in the total disposal length was made for their drainage gaps. Channel right-of-way would extend 5 feet beyond disposal requirements.

3. Relocations. There are three county road bridges, four underground pipelines, and several electric power and communication lines that must be relocated or modified in connection with the improvements proposed. A tabulation of alterations and relocations is as follows:

	Location	Type	Stream
1.	Deep Well Crossing	Road and bridge	South Sulphur
2.	Harper's Crossing	Road and bridge	South Sulphur
3.	Titus Co.-Sulphur River Crossing, 6 miles south of Cuthand, Texas	Road and bridge	Sulphur
4.	Channel Station 195+20	Pipeline (10" gas)	South Sulphur
5.	Channel Station 1664+80	Pipeline (8" gas)	Sulphur
6.	Channel Station 1696+60	Electric Line	Sulphur
7.	Channel Station 1795+10	Telephone Line	Sulphur
8.	Channel Station 1798+20	Telephone Line	Sulphur
9.	Channel Station 2677+00	Pipeline (24" oil)	Sulphur
10.	Near State Highway No. 271	Aqueduct to Talco	Sulphur

(b) Probable impacts

1. Beneficial. A thorough discussion of the impacts of channelization is given in Section 4. This alternative will provide flood protection for 34,000 acres of bottomland hardwoods and 27,800 (10,500 semiwooded and 17,300 cleared) acres of agricultural lands. As a consequence of the realinement of the natural river, a total of 283 acres of oxbow cutoffs would be formed (table IV-3). These oxbows would provide a potential benefit of 9,409 man-days of consumptiv creation and 9,905 pounds of commercial fish, annually, having a combined value of nearly $16,000. Only negligible favorable impacts to community cohesion are expected

because of land requirements, undesirable esthetics, and lack of water supply.

2. Adverse. A discussion of the general impacts of channelization is given in Section 4. This alternative, specifically, would promote the loss of 112 miles (636 surface acres) of stream fishing waters, which is capable of supporting 12,720 man-days of sport fishing and 31,800 pounds of commercial fish having a combined value of $23,850, annually. Wildlife recreation losses were computed for an anticipated project induced loss of 38,600 acres of bottomland hardwoods (11,400 acres for the channel and disposal areas and 27,200 acres from induced clearing) and 13,200 acres of agricultural lands (2,700 acres for the channel and disposal areas and 10,500 acres of semiwooded area which is expected to undergo further clearing due to increased flood protection) (table IV-5). Accordingly, project induced wildlife recreation losses totaled 36,144 man-days valued at $86,262, annually (table IV-4). In addition, an estimated $13,896 in annual fur harvest would be lost. Archeological sites surveyed by Hyatt and Skinner (1971) are located primarily along the north bank of the South Sulphur River in Delta and Hopkins Counties, Texas. The area surveyed extended from below the site of the proposed Cooper Reservoir damsite (river mile 20) upstream to about river mile 44. This plan could affect a total of 13 sites, 10 in Delta County, and three in Hopkins County. Sites that could be affected either by direct excavation of the channel or by dredged material disposal include 12, 30, 32, 33, 37, 50, 53, 54, 58, and 63 in Delta County, and 17, 19, and 20 in Hopkins County (appendix D, now on file at the New Orleans District office). All of these sites are located in the reservoir area, and these sites will have been evaluated and salvaged by the time construction resumes. Below the damsite a total of 33 prehistoric sites were located as a result of an archeological survey conducted by East Texas State University in 1971. A detailed description of all sites located downstream from the proposed damsite that were investigated during the East Texas State University Survey (1971) are given in appendix D, which is now on file at the New Orleans District office. An attempt will be made to avoid any of these sites which could be affected by the proposed construction. If any site cannot be avoided, it will be evaluated for mitigation or salvage. No other known cultural resource would be affected by this action.

(8) Levees only

(a) Project description (refer to plate VI-14). This plan involves strengthening existing levees and building new

levees as required from about a mile upstream of FM Road No. 1880 on the South Sulphur River to about 2 miles above the confluence of Cuthand Creek and the Sulphur River. The proposed levee grades provide a minimum freeboard of 1 foot above the computed flow line elevation for the design flood for all levees except 3RS, immediately upstream from the abandoned P.M.P. R.R., which has a 2-foot freeboard to safeguard against increased water levels at the trestle due to buildup threat from possible log jams. The "net" levee grade is the top of levee profile after an allowance for differential settlement. Ten percent of the height of the levee was used for settlement to estimate the "gross" levee grade for quantity of levee material required. In general, for the enlargement of existing levees, the location of the landside toe of the existing and new levee would be maintained and the centerline of the enlarged levee section would be shifted riverward. The basic levee section would have a 10-foot crown width, a riverside slope of 1 on 3, and a landside slope of 1 on 4. A minimum berm of 30 feet would be provided between the toe of the levee and drainage or borrow ditch excavation. In addition, borrow excavation adjacent to the levees would be limited. Where riverside borrow ditches would be used, earth plugs would be left across the borrow ditches at approximately 0.25-mile intervals. For new levees, the basic section would be the same as for the enlargement of the existing levee. The levee slopes would be graded and then planted with Bermuda grass seed. Prior to the placement of fill material in the levee, all surfaces of existing levees would be cleared and grubbed to a depth of 18 inches where required, and the surfaces to receive fill, would be broken to a depth of 6 inches. Uncompacted fill method would be used in the levee construction. The fill material, which would be obtained from required ditch excavation and/or borrow area, would be placed in the levee section at its natural water content by either hauling or casting equipment. Based on samples obtained by general type borings, the fat clays that would be used in constructing the levee have an average natural water content of from 21 percent to 40 percent. This ranges from about 5 percent below to 8 percent above optimum water content for these fat clays. The lean clays have an average natural water content of about 20 percent, which is about 4 percent wetter than optimum. It is considered that shrinkage of the fill after construction is completed will not exceed 20 percent of the fill volume. An allowance for this shrinkage has been made in the estimated quantities as previously described. The levee work and volume of fill would be as shown in the following tabulation:

Levee	Levee Length	Volume (C.Y.) 30 Year
(E) 4RSS	13,200'	88,000
(E) 3RSS	21,593'	164,000
(E) 2RSS	11,218'	261,000
(E) 1RSS	14,691'	290,000
(E) 1LSS	11,400'	252,000
(E) 3LSS	9,800'	210,000
(Ext) 4LSS	25,300'	340,000
(E) 5RSS	45,500'	1,130,000
(E) 1RN	3,800'	10,000
(Ext) 3RS (Spur)	4,284'	
(Ext) 3RS	22,000'	3,443,000
(E) 3RS	34,544'	(Total-3RS)
(N) 4RS	51,600'	2,634,000

E - Levee enlargement
Ext - Levee extension
N - New levee

Levees 4RS, 3RS, 5RSS, and 4LSS are designed as open end levees and interior runoff would be discharged into the river channels through natural drainage channels and landside drainage ditches. However, single 48-inch corrugated metal pipe culverts with automatic flap gates would be required at station 258+30 on Levee 4RS and at station 5+00 on Levee 4LSS in order to drain water from low points in the drainage system. New drainage structures would be required for loop Levees 4RSS, 3RSS, 2RSS, 1RSS, and 1LSS above State Highway No. 154. The existing drainage structures would be removed. Any extension of the old drainage structures for levee enlargement would not be adequate and the cost of modification would probably be as costly as a new structure. The culverts at other locations may be at too high an elevation to be fully effective. Levees 1RN and 5RSS must be enlarged to handle a 30-year flood. These levees were repaired in 1972 along with Levee 1RS but are not high enough to contain the design flood due to heavy sedimentation in this reach of the river. The drainage culverts for these levees would either be extended as required or new culverts provided, depending upon condition and elevation of the existing structures. If new structures are required, the old structures would be removed. The flap gates on existing culverts would be salvaged and reused where possible. Concrete headwalls are to be provided on the riverside

end of the existing and proposed culverts. On the landside, headwalls have not been indicated as it was found to be more economical to extend the conduit and provide riprap for the protection of the structure. Three metal diaphragms or seepage collars would be provided on each of the new culverts. Outlet ditches would have a minimum bottom width of 12 feet and 1 on 1 side slopes.

1. Channelization. Some channel excavation and realinement is required under this plan since the best flood design location of levees necessitates cutting off some natural channel bends. This amounts to 34,900 feet (6.6 miles) and 643,000 cubic yards of channel excavation, and 65 acres additional right-of-way, all of which must be cleared.

2. Relocations. The following relocations would be required for this plan:

Levee Station	Type of Line	Stream
489+00 (5RSS)	Pipeline	South Sulphur River
199+00 (3RS)	Pipeline	Sulphur River

Additional alterations or relocations may be required which were not available at the time of this study. This has been taken into consideration as a contingency factor in the relocation cost estimate for the project.

(b) Probable impacts

1. Beneficial. A thorough discussion of the impacts of a levee system is given in Section 4. Although this plan requires primarily levees, some channel excavation and realinement is required, since the best flood design location of levees necessitates cutting off some natural channel bends. Realinement would result in abandoning 5 miles of the South Sulphur River and 11 miles of the Sulphur River as oxbow cutoffs (table IV-3). The potential benefits expected from the oxbows include 3,192 man-days of consumptive recreation and 3,360 pounds of commercial fish, annually, having a combined value of $5,400. This alternative will provide flood protection for 12,200 acres of bottomland hardwoods and 16,500 (5,100 semiwooded and 11,400 cleared) acres of agricultural lands. Because of the moderate land requirements for project features and the lack of water supply, negligible favorable impacts are expected.

2. Adverse. Section 4 contains a general discussion of the impacts of using levees. More specifically, this alternative will promote the loss of 16 miles of natural river from channelization (table IV-4). This would result in a loss in potential for 1,920 man-days of sport fishing and a potential harvest loss of 4,800 pounds of commercial fish, annually, having a total combined value of $3,600. Project induced losses in wildlife recreation resources were computed for an anticipated loss of 10,860 acres of bottomland hardwoods (1,100 acres for the levees and limited channelization and 9,760 acres from induced clearing) and 5,400 acres of agricultural lands (300 acres for the levees and limited channelization and 5,100 acres of semiwooded area which is expected to undergo further clearing due to increased flood protection) (table IV-5). Accordingly, project induced wildlife recreation losses totaled 10,437 man-days valued at $24,803, annually. Implementation of this plan would also result in the loss of a potential fur harvest having an estimated value of $3,910. This alternative would produce substantial adverse air and noise impacts during construction, with no improvement in water supply. No archeological sites would be affected by raising existing levees in the vicinity of the reservoir site. Downstream from the dam, the new levee at river mile 152 could affect one large site (TT 40) located approximately 0.5 miles west of the end of the proposed levee. An attempt would be made to avoid this site; however, if this were not possible the site would be evaluated for possible mitigation or salvage. No other known cultural resource would be affected.

(9) Channel and levees

(a) Project description (refer to plate VI-15)

1. Channel. Beginning at a point on the South Sulphur River about 34,000 feet (6.4 miles) below State Highway No. 11, at the end of the existing realined channel, Station 563+00, the new channel would be excavated to a 12-foot bottom width, with 1 on 1 side slopes, and have a bottom grade of 0.00046 with an average depth of 15 feet and a length of about 62,350 feet (11.8 miles). The initial channel capacity would be equal to or somewhat greater than the capacity of the existing channel. It is anticipated that the channel would enlarge to a minimum of 400 percent of its original cross sectional area in a period of 10 years. About 1.5 miles above State Highway No. 154, the channel grade would change to 0.0007 and continue for 42,650 feet (8.0 miles) to intersect the existing realined channel at Station 587+00. The existing realined channel extends downstream past the confluence

of the North and South Sulphur Rivers to about 1.5 miles below State Highway No. 37, Station 1519+00, for a total length of about 93,000 feet (17.6 miles). Continuing from 1.5 miles below State Highway No. 37, the proposed realined 12-foot bottom width channel would be excavated for about 160,000 feet (30.3 miles) to about 1,500 feet upstream of State Highway No. 26 (US Highway No. 259) at Station 3122+00. A stretch of the river from Cuthand Creek to 8.7 miles upstream was cleared for a width of 150 feet for the new channel before project construction was halted. Approximately 16,000 feet (3 miles) of 12-foot bottom width channel was excavated, in this reach prior to the construction halt of this project. A summary of channel work is shown in the tabulation on page VI-31. In the reach of the river from Station 587+00 to Station 1519+50, no channel excavation or realinement is proposed but clearing is required for a 150-foot width measured 75 feet each side of the existing channel centerline.

2. Levees. The levee design and construction required for 30-year flood projection is the same as stated in the "Levees Only" Plan. The volume and length of levee work would be as indicated in the following tabulation:

Levee	Levee Length	Volume (C.Y.) 30-Year
(E) 4RSS	13,200'	50,000
(E) 3RSS	21,593'	116,000
(E) 2RSS	11,218'	221,000
(E) 1RSS	14,691'	236,000
(E) 3LSS	9,800'	201,000
(E) 3LSS	9,800'	0
(Ext) 4LSS	25,300'	300,000
(E) 5RSS &		
(E) 1RS	45,500'	1,030,000
(E) 1RN	3,800'	10,000
(Ext) 3RS		
(Spur)	4,284'	
3RS	22,000'	
(E) 3RS	34,544'	2,869,000
(N) 4RS	51,600'	2,195,000

E - Levee enlargement
Ext - Levee extension
N - New levee

Stream	Realined Channel Length	Slope	Upper Reach		Lower Reach	
			Average Depth	Capacity	Average Depth	Capacity
South Sulphur	62,350'	.00046	17.0'	2620 cfs	19.5'	3500 cfs
South Sulphur	42,650'	.00007	15.0'	2200 cfs	15.0'	2200 cfs
Sulphur	144,250'	.00046	17.0'	2130 cfs	19.0'	2700 cfs

Total length - 249,250 feet
Total length - 47 miles

3. Relocations. There are two county road bridges, three underground pipelines, and several electric power-lines and communication lines that must be relocated or modified in connection with the work proposed. Although the channel may continue to enlarge, it is not considered desirable to provide for expansion beyond the predicted 10-year, 400 percent, figure. The following is a tabulation of alteration and relocations required for the channel and levees:

Location	Type	Stream
1. Harper's Crossing	Road and bridge	South Sulphur
2. Titus Co. - Sulphur River Crossing 6 miles south of Cuthand, Texas	Road and bridge	Sulphur
3. Channel Station 1664+80	Pipeline (8" gas)	Sulphur
4. Channel Station 1696+60	Electric Line	Sulphur
5. Channel Station 1795+10	Telephone Line	Sulphur
6. Channel Station 1798+20	Telephone Line	Sulphur
7. Channel Station 2677+00	Pipeline (24" oil)	Sulphur
8. Near State Highway 271	Aqueduct to Talco	Sulphur
9. Levee 5RSS Station 489+00	Pipeline	South Sulphur
10. Levee 3RS Station 199+00	Pipeline	Sulphur

It is possible that additional alterations and relocations may be required which are not evident at this time. An allowance was added to the cost estimate for the relocations to allow for this contingency.

(b) Probable impacts

1. Beneficial. A discussion of the general impacts of a channel and levees system is contained in Section 4. This alternative will provide flood protection for 11,900 acres of bottomland hardwoods and 16,000 (4,900 semiwooded and 11,100 cleared) acres of agricultural lands. Benefits from the formation of oxbows, as a result of channelization, are the same as those described for the draft EIS plan (table IV-3). Negligible favorable impacts are expected because of land requirements, undesirable esthetics, and the lack of provision of a water supply.

2. Adverse. The general adverse impacts of a channel and levees system are described in Section 4. Specifically,

this alternative will promote the loss of 573 surface acres of natural river which could potentially support 11,460 man-days of sport fishing and a harvest of 28,650 pounds of commercial fish, annually, having a total combined value of $21,488. Project induced losses in wildlife recreation resources were computed for an anticipated loss of 11,320 acres of bottomland hardwoods (1,800 acres for the channel and levees and 9,520 acres from induced clearing) and 5,400 acres of agricultural lands (500 acres for the channel and levees and 4,900 acres of semiwooded area which is expected to undergo further clearing due to increased flood protection) (table IV-5). Accordingly, project induced wildlife recreation losses totaled 10,843 man-days valued at $25,784, annually. An estimated $4,075 in annual fur harvest would also be lost with the implementation of this alternative. Substantial adverse impacts on air and noise would occur during construction, with no subsequent improvement to water supplies. Channel realinement in the vicinity of the reservoir could affect a total of 13 archeological sites located and documented by Hyatt and Skinner (1971). Sites which would be affected either by direct excavation of the channel or by dredged material deposition include numbers 12, 30, 32, 33, 37, 50, 53, 54, 58, and 63 in Delta County, and 17, 19, and 20 in Hopkins County (appendix D, now on file at the New Orleans District). These sites, however, will have been evaluated and salvaged prior to construction. No sites would be affected by raising existing levees within the vicinity of the lake. No other known cultural resource would be affected.

6.03 NONSTRUCTURAL

The water resource development needs of the Sulphur River Basin have been considered intermittently over a period of many years. Several investigations and reports recommending plans of improvement were made prior to authorization of a multipurpose Cooper Lake and Channels project in 1955. Although various alternatives were investigated in previous studies, they were mainly alternate means of providing a positive degree of water resources improvement and did not specifically address nonstructural or environmental considerations.

a. Flood plain regulation (zoning)

(1) Description. This nonstructural alternative encompasses a number of regulations regarding the use of the flood plain such as building codes, zoning laws, etc. The type of regulation used in this discussion is flood zoning which is considered to be land use changes brought about through legal action by the

community or state to encourage or restrict the way in which the resources of the flood plain are utilized. Flood plain zoning cannot be practiced in unincorporated areas of Texas under existing legislation, except for purposes of participating in the National Flood Insurance Program. Building codes that could reduce future flood damages have not been adopted by the counties encompassing the Sulphur River watershed. A land use law is one of the high priority goals of various organizations in Texas.

(2) Probable impacts

(a) Beneficial. Flood plain zoning has been shown to be a most effective means of reducing encroachment of new developments into a flood plain since such development usually occurs without adequate knowledge of the risks involved. Flood plain zoning can be beneficial for areas where structural measures do not provide sufficient flood protection to effectively reduce flood risk. This alternative might reduce the encroachment of new developments into the flood plain and could serve to restore and maintain natural, scenic, and recreational qualities on the Sulphur River. However, this plan would yield minimal recreational benefits because of the inaccessibility of the area to the public. No archeological sites would be affected.

(b) Adverse. The existing development in the Sulphur River Basin is primarily agricultural or rural in nature. This development consists of crops, livestock, farm buildings and equipment, farm roads, highways, bridges, and other rural property. Flood plain zoning could result in the possible relocation of existing improvements that are incompatible with the zoning provisions as well as foreclosing the possibility of future developments, likewise incompatible, which might have occurred in the absence of such regulation. Zoning regulation would disrupt the existing agricultural and economic base of the area and for that reason is considered to be an undesirable solution. The type of restrictions imposed in a particular zoning provision would be determined by the extent of agricultural development affected and the attendant economic losses. Water supply, recreation, the possible conversion of storage space at Wright Patman Lake, and flood control benefits attributable to the recommended plan would be foregone.

b. Flood plain acquisition

(1) Description. Flood plain acquisition involves the acquiring of flood plain areas in lieu of providing flood protection by means of a structural alternative. It is recognized that this

alternative would not prevent flooding, it would only prevent private financial losses attending such flooding. Acquisition of land in the flood plain would require cost sharing by local interest and coordination by the Texas Water Development Board (T.W.D.B.) in accordance with the requirements of its existing Texas Water Plan. This plan would require the acquisition of 89,200 acres of existing flood plain. In order to realize the recreation potential created by the project, recreation facilities would be provided. As discussed previously, the three methods of flood plain acquisition, fee purchase, restrictive easements, and nonrestrictive easements, were also considered in combination with reservoir construction under structural alternatives. Table VI-3 contains a display of the benefits, costs, and corresponding benefit-cost ratio for each of the three methods of flood plain acquisition that were examined.

Table VI-3

Benefit-Cost Analysis Data for Flood Plain Acquisition

Types of Flood Plain Acquisition	First Cost	Annual Cost	Annual Benefit	Benefit-Cost Ratio
Nonrestrictive easement	$11,283,000	$754,000	-	-
Restrictive easement	$18,439,000	$1,149,000	-	-
Fee purchase	$26,985,000	$1,782,500	$492,200	0.3

(2) Probable impacts

(a) Beneficial. This alternative would have a low disturbance impact on the natural environment. Nonrestrictive easement would probably continue to result in clearing by local interests, although, at a much slower rate than with implementation of a structural alternative. Restrictive easement would eliminate further damage to wildlife and fishery populations over 58,000 acres of bottomland hardwoods and 31,200 acres of semiwooded and cleared lands. No increased recreation benefits are attributed to this plan, however, since the status quo conditions would not enhance carrying capacities. With fee acquisition of the flood plain, there exists a potential for intense management of natural resources. This alternative would eliminate the encroachment of

new developments into the flood plain and would serve to restore and maintain natural, scenic, and recreational qualities on the Sulphur River. Table VI-4 presents the anticipated benefits in recreation based on purchase and intense management of the flood plain. These benefits are computed over a greater acreage than for the structural alternative, "Reservoir and Fee Purchase" (see table VI-2), since none of the flood plain will be lost to reservoir construction.

Table VI-4

Potential Recreation Benefits from Fee Purchase of the Flood Plain

Recreation Category	Gains	Value
Big game hunting	6,554 man-days[1]	$ 39,324[2]
Small game hunting	18,243 man-days[3]	36,486[4]
Waterfowl hunting	464 man-days[1]	2,784[5]
Wildlife-oriented recreation	29,000 man-days[1]	43,500[6]
General recreation	246,729 recreation-days[7]	$370,093[8]

[1]Based on purchase and management of 58,000 acres of bottomland hardwoods.

[2]$6.00/man-day - value of big game hunting.

[3]Based on purchase and management of 58,000 acres of bottomland hardwoods and 31,200 acres of agricultural lands.

[4]$2.00/man-day - value of small game hunting.

[5]$6.00/man-day - value of waterfowl hunting.

[6]$1.50/man-day - value of wildlife-oriented recreation.

[7]Represents 10 percent of the market-area demand for the types of activities suitable for development in flood plains.

[8]$1.50/recreation-day-value of general recreation.

(b) Adverse. This alternative would not prevent flooding; rather, it would only prevent private financial losses attending such flooding. Existing structures such as roads, bridges, and utilities would remain in their present locations and flood damage to those facilities would continue. Flood control benefits associated with increased land utilization and flood losses prevented to present agricultural and structural development, would be foregone. Fee purchase of the flood plain would limit the development

of public facilities because of the annual overflow problem. Restrictive easements would have additional adverse impacts on the people and their farms. Any further destruction of archeological sites would be eliminated by fee acquisition or by restrictive easement; however, nonrestrictive easement might lead to some archeological site destruction if land reclamation continues on a private basis. Water supply, a large percentage of the recreation benefits, flood pool conversion in Wright Patman Lake, and flood control benefits would be foregone.

c. Flood insurance

(1) Description. Flood insurance is not a true alternative to flood control since it does not prevent flood losses; it only redistributes the cost of flood losses to a larger area and number of people. Flood damages that occur are a loss within the economy, no matter who ultimately bears the cost. Flood insurance rates are based on 100-year flood protection and cannot be implemented without flood plain regulations in accordance with the Federal Insurance Administration criteria. Agricultural products, such as crops and livestock, are not insurable under the Federal Insurance Administration flood insurance program. Flood control works which provide protection from overflow in the order of a 100-year frequency are usually not justified for agricultural areas. Protection at this level is normally warranted only by the presence of urban-type developments in the flood plain; presently there are no such developments along the Sulphur River System, nor is there any indication that this condition will change in the foreseeable future.

(2) Probable impacts

(a) Beneficial. The benefit of a flood insurance program derives from the fact that private losses due to flood damages are reimbursed to the affected individuals through the flood insurance program. The amount of this benefit must be measured on an individual basis because of its close relation to the type of development and the proportion of the costs and premiums to total development costs. Since the Sulphur River Basin is predominantly agricultural, with practically no structural development proposed in the foreseeable future, little benefit would be derived from a flood insurance program, and it is not considered as a comparable alternative to preventing flood losses. Flood insurance programs are best implemented with flood plain regulation, and accordingly environmental implications of such plans should be considered in concert with flood plain zoning alternatives.

(b) Adverse. Impacts would be essentially the same as those presented under the discussion of "Flood Plain Regulation."

d. Flood warning and evacuation

(1) Description. Flood warning and evacuation systems are particularly effective in reducing flood damages in high-density urban areas that are not subject to flash flooding. These measures may be an exceedingly effective way of preventing loss of life.

(2) Probable impacts. Due to the historical pattern of flooding in this agricultural area, the flood plain has not been used for human habitation and; therefore, loss of life has not been a serious problem. Although early warning of eminent flooding would allow the removal of some farm equipment, supplies, and livestock from the flood plain, it would still leave crops, fences, rural buildings, roads, and other items subject to flood damages. Status quo conditions would not significantly change.

6.04 NO ACTION (Status Quo)

a. Description. (Refer to plate VI-16). The Sulphur River and its tributary streams are located in an area that is largely agricultural with emphasis placed on animal husbandry, consisting of cattle raising and dairy farming. Local interests, initially the individual farmer, constructed small levees along the tributaries. Later, with authorization from State Legislation, larger levee systems were constructed, some being on the main stem of the river. Many of these levees have fallen into various stages of neglect, due in large part to floods and lack of maintenance. The existing flood plain with the levee and channel system completed, at the date of the court injunction, will be considered the "Status Quo" condition. "Status Quo" is the no action alternative studied and as such forms a base from which all other alternatives can be compared. In order to evaluate this alternative, the project areas involved were divided into four reaches. One reach is the area on the South Sulphur River upstream from the damsite, beginning at river mile 23.2 to the upstream limit of the reservoir water surfaces in the vicinity of State Highway No. 11. The second reach is from river mile 23.2 on the South Sulphur River to just below State Highway No. 37 on the Sulphur River. The third reach is from just below State Highway No. 37 to US Highway No. 271 on the Sulphur River. The final reach is on the Sulphur River from US Highway No. 271 downstream to just above State Highway No. 26.

(1) Upper Reach (Cooper Lake Area). This reach of the South Sulphur River contains a flood plain that averages about 0.75 of a mile in width. The channel is fairly small and sinuous with a bankfull capacity of about 2,500 cfs. Local interests, through various levee districts, completed a series of levees about 50 years ago. Some of these levees, including 1RSS(B), 3RSS(B), 4RSS(B), 1LSS(B), and 4LSS(B), are presently breached and overgrown with trees and shrubs. Much of the land behind the levees has reverted back to forest. The floodway between the levees is being built up as a result of siltation. This is caused by erosion of previously constructed channel works and farmlands adjacent to the river. There is a lack of still pools due largely to the steepness of the gradient. At one time users of water had constructed small channel dams in the river but none are in existence at the present time. Water quality varies seasonally due to the nonuniform rainfall pattern which causes erratic streamflow. The quality would be adversely affected by the existence of industry, sewage treatment plants, etc. The present use of the area for recreation is very low because all land is privately owned and even when permission can be obtained for use, the lack of access roads to the river precludes such use. In this reach of the river, 300 acres of land are nonagricultural due to the existence of the channel. Wooded acreage totaling 7,300 acres is subject to flooding from the 30-year flood. The same is true of 3,700 acres of semiwooded and 2,100 acres of cleared land.

(2) Second Reach. This reach, located between the authorized damsite at river mile 23.2 of the South Sulphur River and State Highway No. 37, consists of a stretch of sinuous channel downstream to Bonner Point and an enlarged realined channel from Bonner Point to just below State Highway No. 37. The sinuous channel is fairly small with a capacity of about 2,200 cfs. Small overbank flow above a 2,200 cfs discharge is retained by levees on either side of the channel. Levees further downstream including 1RN and 5RSS have been recently repaired. Opposite Levee 1LS near State Highway No. 37 is the breached Levee 2RS. In this section, 800 acres of land are agriculturally nonusable, 400 acres due to channel, 200 due to levees, and another 200 acres occupied by drainage sumps. Wooded areas totaling 12,600 acres are subject to flooding from the 30-year flood. The same is true of 3,600 acres of semiwooded and 14,800 acres of cleared land.

(3) Third Reach. This reach, located between State Highway No. 37 and US Highway No. 271 on the Sulphur River, consists of the existing levee 3RS that was constructed approximately 20 years ago and now breached. The uncompleted channel work that was begun approximately 20 years ago has led to a silting problem

which has required raising the existing bridge and approach roadway at State Highway No. 37. In this reach, 200 acres of land are nonagricultural due to the presence of channels. Wooded areas totaling 4,900 acres are subject to flooding from the 30-year flood. The same is true of 1,300 acres of semiwooded and 400 acres of cleared land.

(4) Fourth Reach. The lower reach of the Sulphur River below US Highway No. 271 to just above State Highway No. 26 (US Highway No. 259) is the only reach of river that has not previously been improved for flood protection by channel rectification or levee construction. It is essentially in its original state with few access roads. Some farm and ranch roads, available as a result of oil drilling and production, provide limited access to new areas, but generally recreation, farming, and other uses are limited due to the lack of access. A 150-foot-wide floodway was cleared for proposed channel realinement along the Sulphur River over a length of about 46,000 feet upstream of its confluence with Cuthand Creek. About 16,000 feet of 12-foot wide channel has been excavated along the upstream segment of this cleared area. Within this reach, 700 acres of land are nonagricultural due to the presence of the channel. Wooded acres totaling 32,900 acres are subject to flooding from the 30-year flood. The same is true of 3,200 acres of semiwooded and 1,600 acres of cleared land.

b. Probable impacts. This alternative would essentially preserve the flood plain ecosystem in its present condition, however, continued efforts by local interests to control flooding is expected. Success in these endeavors will produce a gradual degradation of the flood plain and its potential wildlife productivity. Even with a minimum success in land reclamation, recreation benefits from the status quo are considered negligible since the majority of the area is not accessible to private individuals. Water quality and quantity are seasonally erratic. This precludes the full development of recreational uses of the rivers and results in inadequate municipal water supplies for the urban areas of Texarkana, Texas, to the east; Sulphur Springs, Texas, to the south; Cooper, Texas, to the north; as well as to the prospective users in the urban areas to be supplied by the Cooper Lake water supply purchasers. Annual high runoff causes flood losses and restricts use of the flood plain for expansion of agricultural pursuits. Silting problems in at least one reach of the Sulphur River have necessitated raising of a bridge and approach roadway. Community cohesion is adversely affected by the dearth of acceptable municipal water supplies and recreational opportunities and by the annual flooding. There is a lack of publicly-owned lands, thus limiting access to the rivers. Employment and income are limited in the

immediate rural community. In the urbanized areas the lack of adequate municipal water supplies restricts economic development. Property values and tax revenues are depressed by these undesirable conditions. Little growth in the population, businesses, or farms is anticipated either on a community or regional basis. Widespread knowledge of the annual flood threat has kept inhabitants out of the flood plain, thereby reducing the dangers to life, health, and safety. Adequate preparedness to cope with the possibility of drought is hampered by the lack of any reserves of water supplies.

SECTION 7--THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.01 RESERVOIR

The implementation of the reservoir feature of the selected plan will inundate approximately 19,000 acres of land and eliminate 21 miles of natural river. These losses of terrestrial and aquatic habitat will result in considerable wildlife and fishery resource losses. Just as significant, however, is the provision of flood protection for approximately 13,000 acres of land and 273,000 acre-feet of much needed water supply for the Cooper Lake area. The reservoir with its recreational facilities would provide the needed resources and development for many types of outdoor recreation which in the past have been quite limited, due primarily to the lack of suitable areas and facilities. Although a reduction in the diversity of fish fauna is likely, a tremendous increase in the standing crop of many species of sport and commercial fishes is expected.

7.02 LEVEES AND CHANNELS

The Sulphur River and its tributary streams are located in an area that is largely agricultural with emphasis placed on animal husbandry, consisting of cattle raising and dairy farming. Local interests, initially the individual farmer, constructed small levees along the tributaries. Later, with authorization from State Legislation, larger levee systems were constructed, some even on the main stem of the river. Flood losses continue to occur, annually, as a result of uncontrolled drainage. The levees and channels feature of the selected plan will provide flood protection for 11,400 acres of land along the South Sulphur and Sulphur Rivers, with an attendant loss of a natural riverine ecosystem and 800 acres of flood plain from project construction. Induced clearing over much of the flood protected bottomland hardwoods will result in sizeable losses in terrestrial wildlife resources and associated recreation potential.

SECTION 8--ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

8.01 RESERVOIR

Approximately 19,000 acres (13,200 acres agricultural land and 5,800 acres of bottomland hardwoods) of land will be permanently inundated by the water supply pool. Following dam closure, the terrestrial ecosystem will be replaced by an aquatic ecosystem. If the reservoir were abandoned after project life, much of this area could be expected to revert to its original vegetative state prior to inundation. That portion of the reservoir receiving a heavy buildup of sediment might succeed to a higher vegetative sere, if the area were no longer inundated. This represents an irreversible and irretrievable commitment of at least a portion of the terrestrial habitat which will be inundated by the reservoir. The reservoir will provide flood protection for 12,900 acres (3,200 acres of bottomland hardwoods, 1,500 acres of semiwooded area, and 8,200 acres of cleared lands) of land below the damsite. An irreversible commitment of approximately 80 percent (2,560 acres) of the bottomland hardwoods and all (1,500 acres) of the semiwooded area is expected as a result of clearing for agricultural uses. Permanent alteration of most floral and faunal resources is expected on that acreage subjected to induced clearing. Ninety archeological sites will be inundated by the lake; however, inundation does not necessarily imply destruction. Submerged sites should be considered only temporarily inaccessible. By the time construction is initiated, sufficient salvaging will have been accomplished to provide minimum mitigation of the loss of archeological resources in the Cooper Lake area. Manpower, material, and energy resources required to construct the reservoir are irretrievable; however, these effects will be mitigated by project-related socioeconomic growth.

8.02 LEVEES AND CHANNELS

The construction of the conveyance channel will result in the realinement of 16 miles of natural channels of the South Sulphur and Sulphur Rivers. This will result in the permanent elimination of several species of benthic fauna and fishes which are indigenous to these natural, sinuous channels. Some 600 acres of bottomland hardwoods and 200 acres of semiwooded or cleared lands are included in the right-of-way for levee construction. Renewable natural

resources associated with the land area eliminated by channelization, although minor, will be permanently lost. Placement of dredged material from channel construction and the construction of levees will alter the existing terrestrial ecosystem. These alterations are irreversible; however, the affected land areas will probably renew with resources somewhat similar to those presently existing. The levees will provide flood protection for 8,700 acres of bottomland hardwoods, 1,800 acres of semiwooded area, and 900 acres of cleared area. An irreversible commitment of approximately 80 percent (6,960 acres) of the bottomland hardwoods area and all of the semiwooded area to agricultural production is expected. This will result in the reestablishment of floral and faunal resources which may or may not be similar to those presently existing. Manpower, material, and energy resources required to construct the levees and channel are irretrievable; however, these effects will be mitigated by project-related socioeconomic growth.

SECTION 9--COORDINATION, COMMENT, AND RESPONSE

9.01 PUBLIC PARTICIPATION

a. Early planning. The early planning on the project was accomplished in response to 10 congressional committee resolutions adopted during the period April 1937 through January 1949 requesting reviews of various existing reports on projects within the Red River Basin. The planning was also accomplished in response to 11 congressional acts adopted during the period August 1935 through July 1946 authorizing preliminary examinations and surveys within the Red River Basin. Public hearings were held during the period 1936 through 1947 at various points through the basin in order to afford local interest the opportunity to express their views and desires on the situation at hand. Seventeen public hearings were held in the upper basin above Fulton, eight in the basin below Fulton, and two were held in Washington, DC. In general, local interests desired navigation improvements, the construction of reservoirs and levees, and channel improvements for flood control and allied purposes, including major drainage, power irrigation, recreation, and municipal water supply. One major improvement desired by local interests in the basin below Denison Dam was the improvement of the Sulphur River and its Tributaries, which consisted generally of construction of Cooper Dam and Reservoir, channel improvements, and levee construction.

On 17 April 1950, the Board of Engineers for Rivers and Harbors issued a public notice describing the improvements which it proposed to recommend in its report in response to the congressional resolutions. This afforded local interests an opportunity to present additional information and their more recent views to the board. Prior to adopting its final recommendations the board gave careful considerations to the communication received. The board filed its report on 20 June 1950.

b. Draft EIS availability. The notice of availability of the draft environmental statement was published in the Federal Register on 18 June 1976. A news release was issued by the office of the New Orleans District Engineer, via local newspaper, and single copies of the draft statement were made available to the public upon request.

c. Public meeting to review draft EIS. On 31 July 1976 a public meeting was held in Commerce, Texas, to review the draft

environmental impact statement. All interested persons were urged to present pertinent factual material in support of their views concerning this document. Of the nearly 650 people in attendance at the meeting, 55 delivered oral statements. Those who presented statements included two members of the US House of Representatives, a representative of the Governor of Texas; various state senators and representatives; representatives of various state agencies, state institutions, and environmental/conservation groups; landowners; and other public interests groups. Nearly unanimous support of the total authorized plan was evidenced at the meeting. Of the 55 speakers at the meeting, only three (Edward C. Fritz, Chairman of the Texas Committee on Natural Resources; Howard Saxion, Inland Conservation Chairman of the Lone Star Chapter of the Sierra Club; and Leland Wommack, resident of the Sulphur River Basin) expressed opposition to one or more features of the authorized plan.

9.02 GOVERNMENT AGENCIES AND OTHERS

The draft environmental statement was sent to governmental agencies and concerned groups requesting their comments. Those comments are summarized below, and appropriate responses are included. A list of those not responding is included in Section 9.03. Letters of comments received are attached in appendix I.

a. Federal agencies

(1) ADVISORY COUNCIL ON HISTORIC PRESERVATION (25 June 1976)

Comment: "Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council has determined that the DES [draft environmental statement] appears adequate concerning compliance with Section 106 of the National Historic Preservation Act of 1966.

"However, with respect to compliance with Executive Order 11593, 'Protection and Enhancement of the Cultural Environment' issued May 13, 1971, we note that the project will result in adverse effects to ninety cultural resources possessing archeological significance, which may be eligible for inclusion in the National Register of Historic Places.

"Therefore, in accordance with Section 2(b) of the Executive Order 11593 and Section 800.4(a)(2) of the "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800), the Council requests the Corps of Engineers to request in writing an opinion from the Secretary of the Interior respecting

these properties' eligibility for inclusion in the National Register and inform us of the findings. The Corps is reminded that should the Secretary of the Interior determine the properties are eligible for inclusion in the National Register, it is required to obtain the Council's comments pursuant to Section 800.4(e) of the procedures prior to proceeding with any portion of the undertaking which will affect the cultural resources. Until the requirements of the Executive Order 11593 and the procedures are met, the Council considers the DES to be incomplete in its treatment of cultural resources."

Response: For informational purposes, it should be noted that cultural resource investigations in the Cooper Lake area began in 1970, conducted by Southern Methodist University (SMU) under the sponsorship of the National Park Service (NPS). The NPS sponsored SMU investigations continued through 1975, at which time the NPS deferred responsibility to the Corps of Engineers for cultural resources on the Cooper Lake project.

SMU under contract to the Corps is currently undertaking a cultural resources study of the area.

A comprehensive evaluation of the Cooper cultural resources will be provided upon completion of the study. This work will be completed in late summer of 1977. Upon completion, required coordination with the Texas State Historic Preservation Officer and the National Park Service will be carried out.

Of the sites that have been located, those that are found to be eligible will be recommended for inclusion in the National Register of Historic Places. The Advisory Council on Historic Preservation will be afforded an opportunity to comment on the sites prior to any action which might directly affect an eligible site.

(2) US DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (25 June 1976)

Comment: "It is noted that the proposed project will require the relocation or alteration of several roads and bridges. More specific information on the relocation of the roads and bridges is needed. Also, vicinity and detailed maps showing proposed channel work in relation to highway facilities would be helpful."

Response: Based on general design documents which have been prepared to date, the Corps has made certain conservative assessments of relocations requirements for roads and bridges that

are expected to be affected by the project. These requirements are identified in Section 1. Specific and detailed information on these relocations will be addressed in separate reports. The reports will be coordinated with appropriate representatives of the Federal Highway Administration.

Comment: "The statement should indicate the extent and magnitude of the change to the Sulphur River (upstream and downstream of the project system) resulting from (a) the impoundment of water by Cooper Lake; and (b) the channel rectivication downstream of the reservoir."

Response: The extent and magnitude of changes to the Sulphur River caused by the project works are fully described in Sections 4 and 5 of the EIS.

Comment: "The statement should also discuss whose responsibility it will be to correct or modify bridges and highways in the future resulting from aggradation upstream of the reservoir, degradation downstream (due to channelization), and possible aggradation (as the river deposits the eroded material)."

Response: Any future modifications to bridges and highways made necessary by possible channel aggradation and/or degradation are the responsibility of local interests. In fulfillment of the conditions of local cooperation for the project features other than the reservoir specified in the authorizing legislation, local interests must hold and save the United States free from damages due to the construction (except where such damages result from the fault or negligence of the United States or its contractors). Local interests must also maintain and operate these works after completion, and preserve channel capacities by preventing encroachment.

(3) US PUBLIC HEALTH SERVICE, VECTOR-BORNE DISEASE DIVISION (6 July 1976)

Comment: "We have found that vector impacts have not been adequately considered, and we believe that provisions should be made for the control of vector problems which might be created by the project.

"Water resources projects have been shown to create extensive vector mosquito-producing habitats unless proper planning to preclude these conditions is done in the early stages of a project. The production of large vector populations increases the risks of vector-borne disease transmission to both humans and animals. The

increased risk of diseases should be considered an adverse impact. The prevention of vector problems, by environmental manipulation, can be accomplished by proper planning, construction, and maintenance, and the inclusion of this type of information in the EIS can be shown as a beneficial effect. Benefits to human health and social well-being, such as vector mosquito control, are commonly overlooked."

Response: Additional information on vector impacts has been included in paragraph 2.05c on page II-38, paragraph 4.02a(1)(b)5 on page IV-6, and paragraph 4.02c(4) on page IV-36.

Comment: "Thirty-seven human cases of mosquito-borne encepalitis occurred in Texas in 1975. Because of arboviral activity in the state, provisions should be made for minimizing or precluding additional vector mosquito-producing habitats. The omission of vector control considerations on any water resources project is an error of considerable public health importance. For completness of the potential impact upon human health, surveillance and control of vector mosquitoes should be discussed in the final EIS."

Response: Concur. Such information has been included in paragraph 4.02c(4)(b) on page IV-37.

Comment: "The subject EIS, page II-65, under 'Insects' states that some insects 'are considered pests and are destructive to man and his endeavors...' Further, on pages C-45 and 46, the impact of the project on the reservoir and the downstream area is listed as moderate for Culex, Anopheles, Culiseta, Aedes, Orthopodomyia, Psorophora, and Toxorhynchites species. On some reservoirs we have surveyed, particularly those not properly prepared before impounding, the impact of Culex, Aedes, Culiseta, and Anopheles species has been extensive. All of the above genera are known vectors in Texas. Therefore, the sponsoring agency should include plans and implement methods for avoiding the creation of additional vector-producing habitats. To reduce the potential for disease outbreaks and the need for emergency chemical control measures, vector prevention and surveillance need to be considered. The following questions should be answered in order to minimize adverse impacts of increased vector-borne disease risks. Which vector mosquito species are found in the project locality, and which ones could be associated with the reservoir? What steps are being taken to minimize breeding areas? What provisions are made for routine inspections and the control of mosquito larvae on the project?"

Response: Requested information is included in paragraph 2.05c on page II-38 and in paragraph 4.02c(4) on page IV-36.

(4) US DEPARTMENT OF AGRICULTURE, FOREST SERVICE (4 August 1976)

Comment: "The sizeable acreage of bottomland hardwoods which would be lost as a direct and indirect result of project implementation is of concern to the Forest Service. This complex and sensitive ecosystem is an extremely valuable and rare ecological resource in this area. The flora and fauna of the bottomlands have evolved and adapted to present conditions of periodic flooding over eons of time. Any change--even the partial drainage proposed in this project--will result in the ultimate destruction of this total bottomland hardwoods ecosystem."

Response: Noted.

Comment: "The impacts of the destruction of this resource are not fully disclosed and analyzed in the draft statement as to:

"1. the limited acreage of bottomland hardwoods remaining in the area, in Texas and in the Nation.

"2. the percentage of the area's limited bottomland hardwood acreage which would ultimately be lost in project implementation.

"3. wood production (based on site capability) which would be lost from project induced clearing and drainage over a 200-year period (100-year project plus minimum 100-year recovery period).

"4. the effect of the wood production loss on local industry in an agricultural economy.

"5. energy costs of the natural production of these bottomlands (wildlife, water, wood, recreation, etc.) versus un-natural and forced agricultural production.

"6. and social, aesthetic, educational and scientific effects."

Response: Based upon some unpublished preliminary data prepared by the US Forest Service for future publication, there were approximately 437,000 acres of bottomland hardwoods within study area counties in 1975. Also, published US Forest Service statistics denote approximately 962,000 acres of bottomland hardwoods within southeast Texas counties. Thus, at least 1.4 million acres of east Texas commercial forestlands support bottomland hardwoods. Comparable data for Texas, as well as the nation, are unavailable at this time.

There would be a loss of approximately 17,470 acres of bottomland hardwoods resulting from implementation of the selected plan (see table IV-5 on page IV-23). Such acreage represents about 4 and 1 percents of the estimated total bottomland hardwood acreages in study area counties and east Texas, respectively.

It has been determined by Corps consultants that a reasonable annual growth rate for hardwoods in the Sulphur River Basin is approximately 22 cubic feet per acre. Based on this evaluation, the annual loss of wood associated with project-related destruction of 17,470 acres of bottomland hardwoods would be about 384,340 cubic feet.

Industrial roundwood production attributable to hardwoods (bottomland and upland species) from counties in the Sulphur River Basin are shown for the years 1974 and 1975 in the following table:

Industrial Roundwood Production from Hardwoods
(Standard cords)

County	1974[1]	1975[2]
Bowie	19,922	7,864
Camp	2,511	710
Cass	31,189	17,822
Franklin	2,344	185
Morris	3,089	2,603
Red River	12,656	3,486
Titus	6,989	659
Wood	14,700	2,067
Total	93,400	35,396

Source: [1]Bertelson, D. F., East Texas Forest Industries, 1974, Southern Forest Experiment Station, New Orleans, Louisiana.

[2]Barron, E. H., Harvest Trends, 1975, Texas Forest Service.

As in[illegible]ated in the table above, annual harvests of hardwoods are quite [illegible]. This is due primarily to market conditions and timber availab[illegible] An assessment of the impact of the annual loss of timber associated with the proposed project (4,270 cords per year) on industrial production within the region would require the disaggregation of such production to upland and bottomland hardwoods types, which is unavailable. It is indicated on page II-37 of the text that there is no significant commercial importance attached to bottomland hardwoods characteristic of the existing

Sulphur River flood plain. However, even if the liberal assumption is made that the entire annual loss of timber due to the proposed project represents a reduction in industrial production, such a decline would have comprised 5 and 12 percents of the 1974 and 1975 harvests, respectively. While this impact might be noticeable for some local economies, the effect on the region would be small. Furthermore, the impact on the entire east Texas forest industry would most likely be minuscule. Thus, although the commercial value of existing timber, which would be cleared due to the flood protection afforded by the proposed plan, was not included in the project economic analysis, the above discussion indicates that inclusion of such a cost would have a minor effect on the project's benefit/cost determination.

The proposed plan would result in increased energy requirements associated with project-induced agricultural production while creating a reduction of energy demands by that which would have been consumed during post-flood conditions within the study area. The net effect of the proposed plan on national energy resources has not been quantified due to the practical immeasurability associated with this project impact.

The matter of esthetics involves a degree of subjectivity regarding the original site appearance (bottomland hardwoods) as well as that induced by the proposed project (cleared agricultural land). The qualities of beauty associated with each of these land uses, however, insure that the overall esthetic impact of the project-induced land conversions would be minor. Also, Appendix B, now on file at the New Orleans District office, contains a listing of all plants reported from the study area with values assigned to each plant denoting its cultural or scientific importance. Although some of those species of bottomland hardwoods are considered of particular value of man, it is stated on pages IV-6 and IV-14 that none of the plant species that would be adversely affected by the proposed plan are considered endangered or threatened. Thus, the adverse impact of the proposed plan on cultural and scientific resources is considered minor.

Comment: "The statement discloses that considerably more flood protection will be provided by the approved reservoir than by the levees and channel facet of the plan. Proposed channelization, under the channel facet, will greatly accelerate silting in Wright Patman Lake and destroy irreplaceable river bottomlands. As a consequence, the environmental and economic costs of the levees and channel facet of the proposal appear disproportionate to purported project benefits. Therefore, we recommend a separate assessment of

the levees and channel portion of the proposal--strictly on its own merits."

Response: An economic analysis of the flood protection provided by the downstream portion of the selected plan--strictly on its own merits--is ascertainable from this document. A comparison between the benefit-cost analyses for the "reservoir only" plan in table VI-1 and the "reservoir and levees" plan shown in the summary of economic analyses at the beginning of this document reveals that inclusion of the downstream works in the selected plan as a flood control feature is economically justified. Further information can be obtained from another planning document, "Alternative Plan Studies," which is available at the New Orleans District office.

Comment: "Your attention is called to a stand of American Chestnut trees, Castanea dentata, located in the project area near the community of Box Elder. This small stand is one of the few remaining seed sources and hopes for perpetuation of the near-extinct American Chestnut species. Every precaution should be exercised to prevent any change in the soil-moisture regime of this mature stand of extremely rare trees."

Response: The small stand of American Chestnut trees (Castanea dentata [Marsh.] Borkh) was located on 24 August 1976 by Dr. Arthur M. Pullen, Professor of Biology, East Texas State University. He investigated the history of the trees and found that members of the King Family brought seeds from Mississippi at the turn of the century and planted them in the locality cited. There are six original plants located on a knoll behind an old homesite (3 are completely dead and 3 are almost dead, each of the latter has only one fruiting branch). Approximately 100 saplings, ranging in height from 2 to 10 feet, are located on a wooded slope a short distance to the east of the original trees. Most of the saplings appear to be disease-free. All of these trees are located a minimum of 10 miles north of the Sulphur River. Other isolated plants have been located as far away as 20 miles north of the Sulphur River. The only possible way that the project could influence these plants or their habitat would be through changes in the water table. Geologists have verified that the water table would not be affected at these great distances from the project area.

(5) US DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, REGIONAL OFFICE (5 August 1976)

Comment: "The Department of Health, Education, and Welfare has reviewed the draft EIS with no objections, but supports the

concern expressed by the Vector-Borne Diseases Division of the US Public Health Service that vector impact and control be more adequately considered."

Response: Concur. Additional information is provided in paragraph 2.05c. on page II-38, paragraph 4.02a(1)(b)5 on page IV-6, and paragraph 4.02c(4) on page IV-36.

(6) US DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (5 August 1976)

Comment: "Page II-5, first paragraph, last sentence - Suggest changing the sentence to read, 'The bottomland soils are loamy to clayey.'"

Response: Referenced sentence, now on page II-4, has been changed as suggested.

Comment: "Page II-5, last paragraph, fifth sentence - Suggest changing the sentence to read, 'Drainage ranges from moderately well to poor.'"

Response: Referenced sentence has been changed.

Comment: "Page II-61, (b) Post Oak Savannah - The second sentence which reads 'The forest type is primarily an oak-hickory complex ...' could be changed to read 'The woody vegetation is primarily oak-hickory....' The reason for this change is that this area is considered a savannah under climax conditions and thus is not a forest.

"The last sentence of the same paragraph - Suggest changing the work 'forests' to 'woods' for the same reason as above."

Response: Appropriate changes have been made on page II-35.

Comment: "Page II-123, first sentence - Change 'Soil Conservation Service' to 'Soil and Water Conservation Districts.' The board of directors are local landowners that are elected to serve as directors of the local Soil and Water Conservation District."

Response: The recommended change has now been made on page II-96.

Comment: "Page 11-138, first paragraph - All of the drainage into the Sulphur River from the north lies in the Northeast

Texas RC&D Project which was approved for operations on June 29, 1975. This project contains proposals for the treatment of the critical areas in the project area. This would greatly reduce sedimentation in the reservoir as well as to downstream areas."

Response: This information has been included as a separate line item in Section 2.11a(3)(b) on page II-108.

Comment: "Suggest including information on the acreage of cropland, crops produced and estimated yields. Suggest giving a breakdown of the agricultural lands into the acreages of grazing land and cropland. Suggest including the acreage of cropland that will be altered by the proposed project."

Response: Reference is made to paragraph 2.08a(2) and (3) on page II-88. Previous studies have acknowledged the existence of such cropping activities as cotton, grain, or soybean production within the Sulphur River flood plain. However, field investigations have reaffirmed the continuing transition from row crops to pasture, and that the current land utilization is almost entirely devoted to grazing. Agricultural lands to be altered by the project are addressed in paragraph 4.02b(1)(b)2 b and 3 a on page IV-19 and paragraph 4.02b(2)(b)2 b on page IV-29.

Comment: "There is no reference to the types, extent and impact of wetlands in the project area according to USDI, Fish and Wildlife Service Circular 39, Wetlands of the United States."

Response: Although reference to Circular 39 was not made, the majority of the lands that will be impacted by the project belong in the category referred to in the circular as "river-overflow lands." The elimination of river-overflow through flood control, is one of the major objectives of the project. Approximately 24,300 acres of overflow lands will be eliminated by the flood control features of the reservoir and the downstream works. Another 8,000 acres of river-overflow will be lost to direct construction features of the reservoir and levees.

(7) US DEPARTMENT OF COMMERCE, DEPUTY ASSISTANT SECRETARY FOR ENVIRONMENTAL AFFAIRS (10 August 1976)

Comment: "The impact statement would be enhanced if a description of flood-producing weather systems were included. Knowledge of the space and time scales of such storms would facilitate assessment of alternatives to the proposed action, especially the applicability of flood warning and evacuation measures."

Response: Flood warning and evacuation systems are particularly effective in high density urban areas. These measures are effective in preventing loss of life in many situations. However, due to the historical pattern of flooding in this area, the flood plain has not been used for human habitation and, therefore, loss of life has not been a serious problem. Early warning of imminent flooding would allow for the removal of some farm equipment, supplies, livestock, etc. from the flood plain, however, it would still leave basic fixed items subject to flood damages. Consequently, a description of weather systems is not seen as an improvement to the EIS and has, therefore, been omitted. Hydrological considerations have been included in many of the design memorandums and in the study of alternative plans.

Comments: "Geodetic control survey monuments may be located within the proposed project area. If there is any planned activity which will disturb or destroy these monuments, NOS [National Ocean Survey] requires not less than 90 days notification in advance of such activity in order to plan for their relocation. NOS recommends that funding for this project includes the cost of any relocation required for NOS monuments.

Response: The NOS will be notified at least 90 days prior to any Cooper Lake project activity that may disturb or destroy any geodetic control survey monuments. Section 73-002 of ER 1180-1-1 states that facilities of other Federal agencies may not be relocated or altered using Civil Works funds, therefore, NOS, an agency of the US Department of Commerce, must fund the relocations with monies programmed by US Department of the Commerce.

(8) ENVIRONMENTAL PROTECTION AGENCY (16 August 1976)

Comment: "Stream channelization typically results in a loss in diversity of aquatic habitat with concomitant loss of associated biota, decreases in the waste assimilative capacity of the stream, and alteration of the riparian ecosystem through construction associated habitat destruction. These impacts are generally severe and a long-term nature."

Response: Concur. Reference is made to Sections 4 and 5 which address impacts expected to result from the planned action.

Comment: "Project associated channelization is to provide 30-year flood protection to approximatley 10,000 acres. Apparently, this level of protection will only be realized after erosion of the pilot channel has occurred. An estimated 8,000 acre feet of

sediment is expected to be discharged into Lake Wright Patman until channel stabilization occurs.

"However, past channel work in the area has indicated that the banks may not stabilize after channelization, resulting in further erosion and water quality degradation. Therefore, we believe that the expected 8,000 acre-feet of sediment to be deposited in Wright Patman Reservoir after erosion of the pilot channel may be a conservative estimate. The impacts of erosion and sedimentation on water quality may outweigh the expected flood control benefits provided by this aspect of the proposed project. Therefore, reconsideration of flood control alternatives seem to be in order."

Response: All alternatives were reconsidered. The "Reservoir and Levees" plan (refer to Section 1) is now recommended for construction. The channelization associated with this plan has a potential sediment contribution of only 1,600 acre-feet into Wright Patman Lake during the 10-year period following construction; i.e. 160 acre-feet per year. Channel enlargement, however, will continue past this time period as a result of further erosion. Channel stabilization will occur when enlargement has progressed to an average of about 1,600 percent. The time required for the enlargement process is estimated at about 30 to 40 years.

The South Sulphur River discharges approximately 140 acre-feet of sediment into the Sulphur River each year, based on suspended sediment measurements made near Cooper, Texas, and an annual flow of 275,300 acre-feet. The Sulphur River carries an estimated 1,360 acre-feet of sediment a year into Wright Patman Lake, based on measurements near Darden, Texas, and an annual flow of 1,670,000 acre-feet [page II-25, paragraph 2.03 b.(3)]. Without the recommended plan, Wright Patman Lake would continue to receive the sediment load it has experienced since its construction. To date, the deposits which have entered Wright Patman Lake have been minimal, due somewhat to the fact that the streambed of the North Sulphur River, which was channelized in 1928, had, for the most part, stabilized prior to the construction of Wright Patman Lake. The channelization work, which was performed in the 1950's under the Cooper project authorization along Cuthand Creek and the South Sulphur and Sulphur Rivers has not resulted in significant deposition in Wright Patman Lake due primarily to the fact that the remaining unchannelized reaches of the Sulphur River above Wright Patman Lake were inefficient in conveying sediments into the lake. Even as the previously constructed channels continue to enlarge, the resulting sediment will not likely be deposited in the lake in large quantities due to the unchannelized segments. If no further

channel works were constructed in the basin, the long-term sediment load entering Wright Patman Lake would consist primarily of material generated by the weathering of topsoils.

Construction of Cooper Lake would reduce most of the 140 acre-feet of sediment per year being discharged from the South Sulphur River into the Sulphur River. As indicated above, the limited channelization associated with the selected plan would contribute approximately 160 acre-feet of sediment per year to the Sulphur River. Accordingly, the net overall effect of the project could be to increase the sediment loading in Wright Patman Lake by approximately 20 acre-feet per year, i.e. less then 2 percent of the present rate. Because of the discontinuity of the proposed channelization, however, the additional sediment would not be deposited entirely in Wright Patman Lake; much of the sediment would be deposited in the overbank areas adjacent to the natural channel.

In summary, after the deposition associated with channel construction has stabilized, the cumulative effects of the channel features and the reservoir feature of the Cooper project will offset one another, with respect to sediment loading, and for the balance of project life, the effects on Wright Patman Lake, with or without the Cooper project, would be minimal.

With the selected plan, as well as with any of the other structural alternatives considered, 30-year flood protection will be realized upon completion of the project.

Analysis of the sediment samples obtained from the Sulphur River between Cooper and Wright Patman Lakes shows that none of the parameters tested exceeded proposed EPA Region VI bottom sediment criteria. The elutriates, resulting from a mixture of these sediments with water from the Sulphur River, exceeded proposed EPA water quality criteria for freshwater aquatic life for only mercury. However, a majority of the background water samples tested (6 of 9 samples) also exceeded the criteria for mercury. Some elutriate samples, while exceeding the criteria, actually had smaller concentrations of mercury than the background water. In addition, one elutriate sample exceeded proposed EPA water quality criteria for public water supply for manganese. The major water quality impact of the channelization of the Sulphur River will be the increase in suspended solids and turbidity to Wright Patman Lake. Assuming that most of the physical conditions in Wright Patman Lake will stay the same (detention time, for example) and assuming the physical characteristics of the increased sediment load are similar to the existing sediment load (particle size for example), the

projected 2 percent increase in sediment load will result in a corresponding 2 percent increase in the suspended solids concentration in Wright Patman Lake. This increase in suspended solids will not appreciably change the aquatic environment in Wright Patman Lake.

Comment: "On Page I-11 it is stated, 'approximately 35 miles of realined channel are required below Cooper dam.' On page I-12 it is indicated that excess excavated material would be disposed of in uncompacted disposal areas. The possible effects on water quality from this disposal of material should be discussed in the final statement. Possible erosion control measures and revegetation should be discussed also."

Response: The selected plan requires about 7 miles of additional realined channel below Cooper Dam. Pages II-25 through II-28 discuss the water quality, elutriate and sediment data obtained from the project area between Cooper and Wright Patman Lakes. The elutriate test results showed that, where comparable, the elutriate values were within proposed EPA water quality criteria for public water supply. The elutriate test was established in order to predict the impact on water quality that a hydraulic type dredge would have. The dredging involved with the limited channel realinement will involve a bucket dredge, resulting in even less of a problem than indicated by the elutriates since bucket dredges minimize the contact between bottom sediments and water. A majority of the excavated material between Cooper Lake and Cuthand Creek will be used to either construct necessary levees or to close the upstream ends of the oxbow lakes created as a result of the channelization. There is no planned channelization between Cuthand Creek and Wright Patman Lake. There will be a potential for some erosion of the levees and dredge material disposal areas with a slight potential for an accompanying increase in the suspended solids concentrations of the channel waters. However, the construction plans and specifications pertinent to this aspect of work will require that the material deposited in disposal areas be dressed evenly in those areas and that suitable gaps be provided in the areas to permit interior runoffs and abate erosion caused by such drainage. These areas will be permitted to revegetate by the natural succession of overgrowth to retain compatibility with surrounding environs.

Comment: "In Table II-8, the lead and cadmium levels are reported as being less than 0.200 and less than 0.05 mg/l, respectively. It appears that the detection limits in the measurement of these parameters are above EPA's criteria of 0.05 mg/l for lead and 0.01 mg/l for cadmium. Mercury is shown in Table II-8 as not being

detected in the water sample. The final statement should include the detection limits for mercury. Before an evaluation of expected water quality can be made with respect to lead, cadmium, and mercury, data reflecting actual concentrations of these parameters are needed. These data should allow a comparison with applicable criteria, requiring that analytical procedures used have detection limits below applicable criteria. If the concentrations of these pollutants exceed the applicable criteria for water supplies, the source of these pollutants and the possible effects they may have on the suitability of this water for use as a source of raw water for public water supplies should be discussed."

Response: The detection limits for lead (0.2 mg/l) and cadmium (0.05 mg/l) were those limits of the instrument available to the US Army Corps of Engineers at the time of the analysis of those particular samples. The detection limit for mercury at that time, as well as now, is 0.00005 mg/l. While table G-5 presents data for lead and cadmium that are not comparable to EPA criteria, tables G-11 through G-19 present additional cadmium and lead data that are of sufficient sensitivity to be comparable to EPA criteria. These tables include both the total and dissolved portions of all parameters tested. As stated on page II-28, only one elutriate value for manganese exceeded proposed EPA water quality criteria for public water supply.

Comment: "The statement indicates that seven sites are designated as recreational and wildlife areas. More information is needed in the final statement concerning the recreational facilities to be provided. For example, the source of water supplies and the disposal of solid waste should be discussed. The treatment of sanitary wastes should also be described, including the type and capacity of the treatment system, the quality of the effluent (if any), and the anticipated volume of wastes to be treated. Also, the possible impacts of increased vehicular traffic on the area's air quality should be considered."

Response: Plans for recreational development are preliminary; the master plan has not been prepared. Determination of waste quantities and design of treatment facilities are not possible at this time. The impacts of increased vehicular traffic on the area's air quality will be insignificant. The water supply, solid waste disposal, and sanitary waste treatment will satisfy all state and Federal requirements.

Comment: "These comments classify your Draft Environmental Impact Statement as ER-2. Specifically, we have environmental reservations regarding the channelization of the stream segment

between Cooper Lake and Lake Wright Patman. We are basing this determination upon the potential long-term degradation of water quality which could result from project induced increases in erosion, sedimentation and turbidity. Our Agency recognizes the need for the water supply which will be provided by Cooper Lake, and must point out that we have no objections to this portion of the project. We are also requesting that additional information on water quality be provided in order to evaluate more fully the environmental impacts of the proposed project."

Response: An alternative plan (refer to Section 1) which minimizes the amount of channelization required to provide the necessary flood control has been selected. Refer to responses to preceding comments relative to channelization impacts.

Tables G-11 through G-19 have been revised to include both the total and dissolved portions of the parameters tested. These data, in addition to the data presented in tables G-1 through G-10 are felt to provide sufficient water quality information to evaluate the environmental impacts of the proposed project.

(9) US DEPARTMENT OF THE INTERIOR, OFFICE OF THE SECRETARY, SOUTHWEST REGION (17 August 1976)

Comment: "The Cooper Lake and Channels Project is a part of water resource development in the northeastern part of Texas. The project will particularly affect water quality, stream modification and control, and the ecological relations of the bottomlands and nearby uplands in the project area. There will also be economic and social effects. The environmental statement is inadequate in its presentation of project description and environmental impacts pertaining to the interrelated Cooper Lake, Wright Patman Lake and Sulphur River channels project."

Response: It is agreed that project implementation will affect water quality and the ecological systems of the project area. Sections 4 and 5 address the economic and social effects expected to result from the project. Paragraph 1.06 on page I-16 of the EIS has been revised to amplify the interrelationships of the project and the Wright Patman Lake project.

Comment: "Known mineral resources of the project and environs include petroleum, natural gas, lignite, sand and gravel, stone and clays. The statement (p. II-17) recognizes the existence of mineral resources in the area but does not describe the effect of the project on such resources."

Response: Deposits of lignite and refractory clays, although present in the area, are not of significant quantity nor suitable quality to warrant economic consideration or production at this time. Quantities of sand, gravel, and stone are scarce in the immediate area of the project. The only significant mineral resources in the area of the project are petroleum and natural gas. There are no known fields or producing wells in the project area which could be adversely affected by the project. Should production be initiated within the project rights-of-way, suitable arrangements will be made to locate drill holes, pipelines, pumping stations, etc., in a manner that is compatible with the project.

Comment: "Page II-2, (c), last sentence - It should be indicated that the artificial character of previously dredged streams in the project area is esthetically inferior to unalerted [sic] stream segments which still retain their natural stream cover."

Response: We agree that channelization results in a condition considered esthetically inferior by many. Reference is made to pages IV-26 through IV-32 for a discussion of the adverse effects expected from the channelization of certain segments of the natural river. These impacts would also be applicable to the completed channel works.

Comment: "Page II-55, (5) - A table depicting the median monthly streamflow under pre-construction conditions, particularly at the Cooper Lake damsite, would be helpful in understanding the comparison of with and without project conditions."

Response: Requested information is presented in table II-4 on page II-29.

Comment: "Page II-65, d. - The American alligator is known to inhabit the Sulphur River Basin. In addition to the remnant native population, the Arkansas Game and Fish Commission released approximately 150 alligators at the Sulphur River Wildlife Management Area in Miller County, Arkansas, during 1971, 1972, and 1973, as a part of the Arkansas Game and Fish Commission endangered species management program."

Response: This information is included in Section 2.05d on page II-40 of the EIS.

Comment: "Page II-71, (2) - The incompleteness of proposed project channelization makes a comparison of fishery resources with and without channelization invalid. The comparison of channelized

and unchannelized reaches presented here is taken from partial channelization accomplished 15 years ago and overlooks the beneficial effects of the unchannelized stream segments in retarding streamflow, maintaining higher surface water and ground water elevations, and reducing silt and sediment loads in previously channelized portions above or below natural stream portions. It also omits the effects of regulated streamflow below the dam following construction. The most accurate description of fish compositions and habitat conditions following channelization is best illustrated in the description of North Sulphur River and Cuthand Creek, where channelization is virtually complete."

Response: It is agreed that a more accurate description of fish compositions and habitat conditions following channelization is best illustrated in the description of North Sulphur River and Cuthand Creek, where channelization is virtually complete; however, for the sake of scientific objectivity, comparisons of all types of channelized conditions are shown. It is especially important to know the conditions in the partially channelized Sulphur River, since at any time during the planning process, a recommended action can be modified. In other words, the decision maker should know if continued channelization of the Sulphur River would actually worsen the aquatic habitat or if the partial channelization had already totally destroyed the aquatic ecosystem. If the latter statement were true, a decision to minimize the channel feature of the authorized plan (draft EIS plan), for environmental reasons, may not have been justified.

Comment: "Page II-71, (4) - For purposes of comparison, the year in which channelization was conducted in North Sulphur River and Cuthand Creek should be cited."

Response: Channelization was conducted by local interests on the North Sulphur River in 1928. In 1959, the Corps of Engineers channelized a reach of Cuthand Creek.

Comment: "Page II-79, (2) - The comparison of deer population and harvest data compiled by Alexander, 1972, and others is confusing. Supporting information regarding the size, location, and physical differences of the study areas should be presented."

Response: The data contained in Alexander's (1972) Job No. 2 Report is an average figure for all deer range (primarily uplands) in northeast Texas and is therefore not as directly applicable as the data presented in Table II-30, which was compiled specifically for the Sulphur River Basin. Accordingly, paragraph

2.05h.(2) of the draft EIS which contained the conflicting data has been deleted.

Comment: "Page II-82, b. - The type of recreationists which do not prefer the river for recreation should be identified. It is our opinion that sport fishermen, who comprise a high percent of the total users, have historically preferred stream fishing."

Response: The referenced paragraph generally addresses the natural recreation conditions of the Sulphur River Basin. The sentence which reads "use of the Sulphur River for water-oriented recreation has, in the past, been limited because of the seasonal and undependable flow of the river, lack of adequate access, and because water in this form is not highly preferred by recreationists" apparently stimulated the above comment. With the aforementioned constraints plus other physical characteristics such as high, erosive banks and high turbidity, it is our contention that the general recreating public would not prefer to conduct such activities as boating, waterskiing, canoeing, swimming, picnicking, etc. in streams such as the Sulphur River. Existing usage of the streams in the study area, however limited, does probably include a significant percentage of stream fishermen.

Comment: "Page II-111, (2) - The final environmental statement should contain evidence of contact with the State Historic Preservation Officer and include his comments concerning the effect of the undertaking upon any cultural properties in the process of nomination to the National Register of Historic Places."

Response: The draft environmental statement was coordinated with the Texas State Historic Preservation Officer (SHPO) through the State Planning Coordination Office. No comments were received from the SHPO relative to cultural resources. The Corps of Engineers is funding an evaluation study of the cultural resources identified by the previous National Park Service sponsored investigation. The results of this study will also be coordinated with the Texas SHPO.

Comment: "Page II-134, 5. - It is not clear why attitudes of 'residents' are discussed in section 4 on impacts while attitudes of 'leaders' are discussed in section 2 on pages II-128 through 131 and summarized as a display in table II-45."

Response: The attitudes of both "leaders" and "residents" were discussed in Section 2 on pages II-98 through II-105 (note the reference at the top of page II-96 to 269 "leaders" and 84 "residents" interviewed during the 1971 survey). The general

attitudes on water resource topics, presented in table II-29, is considered to be appropriate for presentation in Section 2.

Segments of both the 1971 and 1972 surveys dealt with attitudes of respondents to the Cooper Lake and Channels project specifically. For this reason, this information is considered to be appropriate for presentation in Section 4, which deals specifically with the impacts of the proposed Cooper project. As indicated on page IV-10, the respondents included both "leaders" and "residents."

Comment: "Page II-137, 2.11, (1) - The beneficiary of the additional 120,000 acre-feet of water supply allocated to Wright Patman Lake should be identified as the International Paper Company, not the city of Texarkana, Texas. The use of the reservoir water by the paper company was granted by the Corps in July 1968. In the Corps of Engineers' letter to the U.S. Fish and Wildlife Service, dated July 3, 1968, it is stated:

'The city of Texarkana, Texas, has requested that the U.S. Army Corps of Engineers provide from the Texarkana Reservoir on an interim basis until Contract No. DACW29-68-A-0103 becomes effective, a water supply of 84 m.g.d. This water would be for the use of the International Paper Company - 28 m.g.d. for process purposes and 56 m.g.d. for water quality control. The U.S. Army Corps of Engineers has determined that, by revision of the current operating rule curve procedure, the 84 m.g.d. requested by the city of Texarkana, Texas, can be furnished.'"

Response: It is true that the International Paper Company (IPCO) currently benefits from the interim water supply provided at Wright Patman Lake. It should be noted, however, that the IPCO received this benefit through operating agreements with the city of Texarkana, Texas, and not through agreements with the Government. The Government has entered into contractual agreements with the city of Texarkana (Contract No. DACW29-69-C-0019) which permits that city to use, on an interim basis, a portion of the space which will be made available if and when a space conversion is accomplished; and which future space the city has agree to purchase from the Government after such a conversion is realized. The Government is authorized to sell space in its reservoir projects to public entities; it may not, however, enter into agreements with private agencies for such purchases.

Comment: "Page II-139, b. - Based upon a Texas Water Development Board preliminary plan for 'Proposed Water Resources Development in the Sulphur River Basin' dated 19 June 1966, two additional reservoirs Sulphur Bluff I and Naples, and enlargement of Lake

Texarkana (Wright Patman Lake) will be required by the year 2020 to satisfy water supply needs inside and outside the basin. These projects, if initiated, would have a tremendous impact on the natural resources of the project area and should therefore be addressed."

Response: The Texas Water Development Board (TWDB) has formulated a preliminary Texas Water Plan intended to fulfill future water needs for the State of Texas. That preliminary plan, although approved by the State legislature, has not been implemented due in part to the failure of popular support for requisite bonding proposals. The Naples and Sulphur Bluff reservoirs, originally planned for construction below the proposed Cooper Reservoir, were elements of the preliminary water plan. These features of the plan, if constructed, would have resulted in major impacts to the Sulphur River Basin and would have inundated portions of the downstream levees and channels associated with the Cooper project and would also have required structural modification of the dam. Since the formulation of the preliminary plan, however, the Corps has received correspondence from the TWDB, which states that consideration of those two downstream reservoirs should be eliminated from project planning since the construction of those features would not be expected in the near future. In the absence of definitive formulation and legislative and popular approval of a final water plan for the State of Texas, the immediate assessment of the impacts of such a plan is impossible.

Comment: "Page IV-2 - An explanation regarding the frequency and duration of zero flow periods would enable the reader to analyze the benefits derived from a minimum release of 5 c.f.s. The downstream flows from the reservoir perhaps will not result in enhancement of overall stream conditions for fish populations. However, the miminum flow release of 5 c.f.s. should have beneficial impacts compared to the sometimes existing no-flow conditions. This should be stated."

Response: A review of the runoff pattern for the South Sulphur River near Cooper, Texas, gage indicates that during the past 33 years there have been 25 years in which a zero flow was recorded. In other words in 3 out of every 4 years, there have been periods of no flow. The year with the most numbers of days recording zero flow was 1956 when records indicate 221 days of zero flow. During the period of record, 1943-1975, there were 1,917 days of zero flow or about 16 percent of the time, zero flow was recorded. Beneficial impacts of a minimum flow release are discussed in Section 4.02a(1)(b)1.a.(2) on page IV-3.

Comment: "Page IV-2, 3. - Data to support the statement that long-term water quality will be improved in Wright Patman Lake due to sediment removal at Cooper Lake should be provided. We believe that channel and levee construction and project-induced land clearing will result in increased sediment and pesticide loads in the Sulphur River and Wright Patman Lake. A with and without project analysis of the total sediment deposited in Wright Patman Lake would be helpful in understanding the impacts and should be provided in the final environmental statement."

Response: The statement made on page IV-2, paragraph 4.02a(1)(a)3, refers specifically to the impact resulting from the reservoir only. However, it is agreed that the net effect of the total, currently recommended, project will result in a slightly negative impact on the long-term water quality in Wright Patman Lake (see response to EPA comment on page IX-13).

Project-induced land clearing will result in increased sediment and pesticide loads in the Sulphur River and Wright Patman Lake. These increases, however, can be minimized by proper application of pesticides and improved farming techniques such as minimum tillage.

Comment: "Page IV-5, b. - Impacts on vertebrate and invertebrate forms within rights-of-way for the reservoir are discussed; however, the impact of human disturbance on the 3,300-acre area to be developed for recreation, 6,275 acres for other project purposes, and development of adjacent private land as a result of the project is not addressed."

Response: It is recognized that a change in land use is considered an impact dependent upon an individual's personal interest. However, it is not anticipated that the human disturbance on the 9,575 acres of right-of-way to be any more severe than if this area were to continue in private ownership. Of this area, 6,625 acres are presently in agricultural production, which includes row crops and heavy grazing. Under Federal ownership, reforestation of most of this area is probable. Accordingly, it is expected that the beneficial impacts of allowing the area to go fallow will far exceed the adverse impacts of allowing public access.

The 6,275 acres "for other project purposes" will probably be dedicated to fish and wildlife purposes in the form of mitigation for project induced fish and wildlife losses as noted on page IV-35. The type and severity of impacts would, of course, depend on the particular use made of the area. Use of this area would be determined by the Texas Parks and Wildlife Department.

Any significant alteration of land ownership or habitation patterns due to the reservoir would occur near lands currently devoted to urbanization. There would be no effect on such patterns within the existing flood plain. Thus, the project would have minor adverse impacts on desirable community growth patterns within the study area.

Comment: "Page IV-6. The statement that, '...a variety of seed producing annual grasses may invade the moist shoreline,' is speculation. A dependable source of seed for waterfowl is not common on unmanaged areas at this latitude."

Response: It is agreed that the referenced statement is speculative in that it states "...annual grasses may invade...." No inferences are made regarding the dependability, quantity, or quality of the seed source as waterfowl food.

Comment: "The American alligator, known to occur at the Arkansas Game and Fish Commission's Sulphur River Wildlife Management Area, could be affected by further modification of downstream release below Wright Patman Lake. Extended periods of minimal flow (10 c.f.s.) would be particularly detrimental to this species. Contrary to the statement, "The project will not adversely affect any known critical habitat for threatened or endangered species," the Governor of Arkansas, in a letter dated October 20, 1975, requested the Secretary of the Interior to declare the Sulphur River Wildlife Management Area as critical habitat for the American alligator. Although final action has not been taken on this request, the EIS should indicate that the project could import [sic] critical habitat if the state recommendation is fulfilled."

Response: The exchange of storage between Cooper Lake and Wright Patman Lake will not alter the magnitude of the low flow release rate at Wright Patman Lake. The low flow release rate will be maintained at 10 c.f.s. Theoretically, the duration and occurrence of the low flow release may be expected to slightly increase as a result of the greater utilization of rainfall runoff above the damsite. However, the increased utilization of water is only a small percentage of the annual runoff and in many instances there will be no noticeable effects on the duration of low flow release. Consequently, the net effect of the conversion of storage on endangered fauna is considered negligible. The influence of the storage conversion in Wright Patman Lake will be covered in greater detail in a separate EIS for that action, prior to initiation.

Comment: "Page IV-6 and IV-15 - The fact that there will not be an adverse effect does not constitute a beneficial effect

due to the project. Perhaps this type of information would be appropriate in the opening paragraph on the Nature of Impacts rather than in either beneficial or adverse impacts."

Response: We agree with your observation that the lack of an adverse impact does not necessarily constitute a beneficial effect; however, the information contained on the pages cited is considered appropriate in the discussion of beneficial impacts, therefore, the information has been retained in its present format.

Comment: "Page IV-7, (c) - The 'most similar project' concept used to predict initial and total day-use at Cooper Lake (Table IV-I) takes into account several factors mentioned on Page IV-8. However, another factor which would have a significant impact on surrounding facilities would be the loss of man-days and related income due to the redistribution of recreationists as a result of Cooper Lake construction. The ability of our modern society to travel 50 or more miles to a new reservoir where fishing and water contact recreation facilities exist makes the opportunity for 'shifting' recreationists a very real consideration which should be a part of the day-use analysis."

Response: The procedure for selecting "the most similar project" includes the consideration of competing recreation resources. Cooper Lake is to be constructed within Texas Planning Regions 12 and 13. There is (according to the Texas Outdoor Recreation Plan) a significant need for the types of recreational facilities to be provided at Cooper Lake. So, even though there will probably be some shift in use from existing recreation resources, the need for these recreation opportunities will insure that no reduction in use occurs. As a result of further review, the general recreation visitor days have been changed to reflect the latest approved estimate.

Comment: "Page IV-10, Table IV-2 - In light of suggested dollar values assigned to various types of hunting and fishing by the Water Resources Council's 'Principles and Standards for Planning Water and Related Land Resources,' the dollar values assigned to man-days of hunting and fishing seems low."

Response: Since the proposed project was authorized prior to 25 October 1973, it is required that use be made of unit day values within the range established in Senate Document No. 97 (87th Congress, 2nd Session; approved by the President on May 1962). Although these values may seem somewhat conservative, the highest allowable unit day values, within the range allowed in Senate Document No. 97, were used for the various types of recreation. In addition, consistency was maintained in assignment of recreation values for estimating both benefits and costs to

recreation resources; thus, comparisons of benefits and losses are considered valid.

Comment: "Pages IV-11 and IV-16 - On pages II-123 the statement is made, 'These respondents are not necessarily representative of the population since the sampling techniques used were not entirely random.' The conclusion that the project is widely supported may be faulty if biased methods were used to select interviewers."

Response: Dr. Raghu D. Singh, in a telephone conversation on 7 October 1976, indicated that the community leaders were sampled through a "snowball" technique which yielded a sample of nearly 95% of the total leaders. He also said that the area residents were sampled through an "area sample" method; which involved mapping the total area, subdividing the area into blocks, and sampling a certain percentage of the occupied residences of each block. He indicated that both the "snowball" and "area sample" methods of sampling were acceptable procedures in sociological research, and that he was fully confident that both samples yielded respondents who were representative of the population. Accordingly, the referenced statement on page II-123 of the draft EIS has been deleted.

Overwhelming support for the project was demonstrated at the 31 July 1976 public meeting (refer to Section 9.01c on page IX-1).

Comment: "Page IV-14 - We agree the reduction in overbank flooding of oxbow cutoffs should reduce the chance for contamination from agricultural chemicals in the river. It should be pointed out, however, that these isolated bodies of water, particularly near agricultural croplands, are benefitted by the 'flushing' effect of periodic overflow, which reduces the accumulation of agricultural chemicals in runoff from adjacent cleared land."

Response: The requested addition has been made in paragraph 4.02a(2)(b)1 on page IV-12.

Comment: "Page IV-14, (3)a. - The method of controlling woody growth on levees should be identified. Mechanical controls are preferred over chemical sprays to minimize fish and wildlife resource damages."

Response: The most widely used method of controlling vegetation on the levees and dam embankments is by mowing at advantageous intervals favoring continuing herbaceous growth but limiting

the height of growth so that growth of woody species is effectively inhibited. Because of the agrarian economics of the area, the herbaceous cover is highly valued for livestock grazing. Herbicidal control is normally combined with grazing to eliminate noxious weeds that adversely affect livestock. The type of herbicide that will normally be used is 2,4-D; the toxicity, rate of application, and concentration used is relatively harmless to both domestic and wild animals. The actual choice of any herbicide or specific limitation on use by local interests is not controllable by the Corps of Engineers. State agencies and the Environmental Protection Agency will enforce available regulatory controls over the use of herbicides. It may be necessary to inoculate some heavy woody growth that has developed or may develop in relatively inaccessible areas or under conditions that are not amenable to ordinary controls. The operation and maintenance manual for the project will be developed by the Corps of Engineers; it will include recommendations, options, and requirements for control of vegetation on the levees and dam embankments. The manual will be a part of the necessary local cooperation agreements with involved Texas county commissions.

Comment: "Page IV-15, (2) - Due to the projected loss of 7,920 acres of bottomland hardwoods and 1,800 acres of semiwooded lands expected as a result of the proposed levee and channel features, the Fish and Wildlife Service disagrees with the statement that, '...the losses in woodland acreage may be compensated for by an increase in edge.'"

Response: Disagreement noted, however, reexamination of the actual content of the referenced information (section 4.02a (2)(b)3 b(2) on page IV-14) indicates only specific species of birds that may be benefitted by the increased edge. This information does not imply, nor was it intended to imply, that all adverse impacts resulting from the loss of forested areas will be compensated for by an increase in edge habitat.

Comment: "Page IV-15, (3) - The opinion that several wildlife species, including oppossum, raccoon, fox, squirrel and white-tailed deer, will be benefitted by induced clearing and increased agriculture is unjustified. The 8,400 acres of bottomland hardwoods and semiwooded native pastures affected by induced clearing support a potential carrying capacity for these species and many other game and non-game mammals which far exceeds that of cropland and improved pasture."

Response: It is the opinion of Corps of Engineers biologists that, unless large tracts of bottomland hardwoods are cleared; intermittent patches of cleared timber will quite possibly

improve habitat conditions for the species listed. Under the conditions stipulated here and in the referenced paragraph now on page IV-14, an important factor in improving habitat in this area is the increase edge effect.

Comment: "Page IV-16, (c) - The hunting and fishing benefits derived from oxbow cutoffs seem to be overly high in view of the statement on Page IV-36, first incomplete paragraph that, "...the benefits to be derived from these lakes were not sufficient to justify the costs of constructing the access routes." It would seem that if 11,737 man-days of consumptive recreation valued at $18,000 and an annual harvest of 12,355 pounds of commercial fish valued at $1,900 could be obtained without public access, the inclusion of access would create a significant increase in recreation man-days and commercial fish harvests."

Response: The economic feasibility of providing access to the oxbows was recalculated. Results confirmed the earlier determination that provision of access to the oxbows is not justified.

Comment: "Page IV-19, a. - The use of the word 'only' is inappropriate in view of the 80 percent loss of woodlands. A discussion of the impact of this timber loss on the local timber industry, and an analysis of the project construction or induced losses in comparison with the total basin bottomland forest should be provided."

Response: The word "only" has been changed to "approximately" on page IV-19. See response to US Forest Service comment on page IX-6.

Comment: "Page IV-19, 3 - It should be mentioned that private, residential, and recreational development outside the take line boundary would also contribute to flora alterations within the basin."

Response: Should such development result, it is agreed that floral alterations would be incurred. However, significant alteration of land ownership or habitation patterns within the flood plain, as a result of the reservoir construction is not anticipated. Accordingly, only minor floral alterations outside the take line boundary of the reservoir are expected to occur.

Comment: "Page IV-21, (4) - It is our view that the loss of bottomland hardwoods and semi-wooded native pastures will have a significantly greater impact on white-tailed deer than the loss of

agricultural crops, which provides a seasonal food source to supplement the deer's natural diet."

Response: Concur. Referenced information on page IV-21 has been revised accordingly.

Comment: "Page IV-21, 4. Endangered and threatened species - Lack of information concerning the effects of reallocation of flood storage on downstream releases below Wright Patman Lake causes us to seriously question the statement, 'None of the endangered fauna will be adversely affected by the reservoir.' Further reduction in overall reservoir releases and increased periods of minimum flow could adversely affect the American alligator in Arkansas. Based upon discharge data published by the Corps of Engineers since 1959 and available through 1973, minimum reservoir releases of 10 c.f.s. have been maintained. The average number of recorded minimum flow days is 70. A maximum number of minimum flow days (a total of 219) occurred in 1972 and the minimum number (no days occurred in 1968)."

Response: See response to previous comment on page IX-24.

Comment: "Pages IV-21-25 and Pages IV-31-32 - Pertinent background information depicting conditions and time periods upon which potential losses are based would be helpful in evaluating effects of the project on consumptive and nonconsumptive use. It is our belief that potential man-day losses described in this section are unrealistically low in view of the high quality of fish and wildlife habitats affected. A more liberal monetary value assigned to the specific types of hunting and fishing should also be considered to bring these values in line with suggested values contained in the Water Resources Council's 'Principles and Standards for Planning Water and Related Land Resources.'"

Response: Comparison of the data presented in table II-12 on page II-53 and table IV-4 on page IV-22 indicates that the Corps estimate of potential man-days per acre of small game hunting in the bottomland hardwoods region of the basin is over 1.5 times higher than the estimate furnished by the Texas Parks and Wildlife Department. In addition, the estimate of potential man-days of big game hunting that could be supported by the bottomland hardwoods of the basin is virtually the same as the Texas Parks and Wildlife Department estimate.

Estimates of waterfowl losses have been revised upward throughout the EIS; a summary of these revisions and their effect on the total estimated wildlife and fishery project-induced losses is contained in table IV-4.

Estimates of losses in furbearer resources have also been computed for the recommended plan and various alternatives (refer to table IV-4). These computations are based on data from the Texas Parks and Wildlife Department as indicated on page IV-25.

The only data, furnished to date, which includes an estimate of losses in man-days of sport fishing was provided in the 1966 letter report from your agency. The estimate of losses in man-days of sport fishing, that would have been induced by channelization in the authorized plan, exceeded the estimate by 500. However, since approximately 80 percent of the formerly anticipated channelization has been eliminated, by selection of the Reservoir and Levees alternative, estimated losses in man-days of sport fishing have been reduced proportionately.

Although no estimate of losses in man-days of nonconsumptive recreation was provided by either your agency or the Texas Parks and Wildlife Department, it is considered that the Corps estimate is quite liberal.

Regarding your suggestion that we use more liberal monetary values, see the response to your comment on page IX-25.

Comment: "Page IV-27, (2) - The duration of erosion and high sediment loads resulting from channel construction and natural stream cutting should be discussed. Based upon the obvious effects of channel widening and erosion resulting from channelization of North Sulphur River, the possibility of long-term or conditional erosion and sediment problems should be pointed out in the statement. Due to the construction of a 10-foot-wide channel on the lower 35 miles of North Sulphur River several years ago, the Soil Conservation Service in recent years has initiated a Resource Conservation and Development project program in the drainage area to control further widening and erosion of the North Sulphur River which at this time is approximately 300 feet wide. We also believe the increased cost of water treatment by Wright Patman Lake water supply users should be more specific. A sentence in this paragraph reads, 'Consequently, an increase in the cost of drinking water treatment could be experienced for users from Wright Patman Lake.' A paragraph on water quality on page IV-2 reads, 'This may decrease the cost of water treatment for users of water from Wright Patman Lake.' Each statement is made in reference to sediments, and each statement is correct in context. The two statements do illustrate the problem of keeping the many phases of the total statement in context."

Response: The increase in cost of drinking water treatment by Wright Patman Lake water supply users would result

from the increased sediment load to Wright Patman Lake caused by the channelization of the Sulphur River upstream. The decrease in cost of drinking water treatment would result from the construction of Cooper Lake which would remove some of the sediment load presently entering the Sulphur River from the South Sulphur River. With the newly selected plan, the net effect of the two actions would result in a minimal increase in sediment deposited in Wright Patman Lake with a correspondingly negligible increase in the cost of drinking water treatment.

A thorough discussion of the net effect of channel erosion and sedimentation is contained in a response to a similar comment by EPA on page IX-13.

Comment: "Page IV-35, (b) - The 6,000 acres purchased for project purposes, would not provide adequate mitigation for fish and wildlife habitat losses incurred by the project reservoir, levee and channel features. Furthermore, based upon experience, the reservoir operation plan would have priority over any management plans recommended or initiated by the Texas Parks and Wildlife Department, thereby restricting the potential for wildlife management."

Response: The Corps position on additional mitigation is presented in Section 5.07b(4) on page V-4.

Comment: "Page IV-36 - The exclusion of public access at oxbow lakes created by channel alignment may warrant recommendation changes to include as an alternative to developing oxbow lakes, the recommendation that natural channels serve as the primary system for conveying normal flows. The aligned channel could, therefore, convey flood releases and runoff exceeding normal stream flow elevations. This alternative could provide continued access to boats carrying sport and commercial fishermen, waterfowl hunters, and nonconsumptive recreationists."

Response: Because of limited excavation of realined channels in the selected plan, the natural channel will serve as the primary system for conveying flows. Accordingly, continued access for boats would be available in the natural channel when flows permit.

Comment: "There is a lack of meaningful information concerning Wright Patman Lake within the draft statement. We request that the final statement discuss the enlargement of Wright Patman Lake for water supply (120,000 acre-feet), and background information concerning the National Pollutant Discharge Elimination System

permit for the International Paper Company discharge below Wright Patman Lake. Furthermore, the concerns of Federal, State and private agencies and groups regarding the fish and wildlife impact of these alterations should be presented in the form of pertinent correspondence containing comments from all agencies concerned. Previous comments by the Fish and Wildlife Service point out that due to the reduction of downstream releases numerous fish kills have occurred and inadequate releases have resulted in substantial detriment to navigation for small boats in the Sulphur River Wildlife Management area, the primary means of access to and through the State-owned area."

Response: Paragraph 1.06 on pages I-16 through I-19 of this EIS has been expanded to address the effects of the Wright Patman Lake storage space conversion.

Section 402 of Title IV of the Federal Water Pollution Control amendments of 1972, Public Law 92-500, established the National Pollutant Discharge Elimination System (NPDES). In compliance with the requirements of that law, the International Paper Company (IPCO) applied to the Environmental Protection Agency (EPA) for a permit (permit no. TX0000167) to discharge its Texarkana plant effluents into the Sulphur River below Wright Patman Lake. In response to this application, the EPA conducted a public meeting on 10 December 1974 in order to obtain information bearing on its final determination regarding the application. On 28 December 1974, the EPA granted the NPDES permit for IPCO. The paper company, thereafter, submitted an application to EPA for a permit to authorize discharges in conjunction with an expansion of the Texarkana plant. Public hearings for this application were conducted on 10 December 1975, and a permit granted on 31 December 1975.

The concerns and comments of various agencies and groups have been included in Section 9. A sincere effort has been made to adequately respond to all comments.

Comment: "Page V-2 - This paragraph could be restated. Air and noise factors do not usually deteriorate water quality."

Response: Appropriate changes have been incorporated on pages IV-32 and V-2.

Comment: "Plate II-2 - The map indicates that the reservoir will not conflict with known oil or gas fields; however, levees 3RS and 4RS might overlap an unnamed oil field in Franklin and Titus Counties. Also, the document indicates that most oil in the region is produced from fault traps (pp. II-2, II-15, II-17). Because

several faults occur within the project area, we suggest that the final draft of the EIS discuss more fully the possibility of new oil and gas discoveries in the area and indicate Corps of Engineers policies toward such exploration and production from within the project site."

Response: The apparent overlap stems from the small scale of the map. A check of the location of levees 3RS and 4RS on a larger scale map indicates that these levees will not interfere with the operation of the unnamed oilfield. Levee alinements are made to minimize unnecessary relocations or disturbances to oil and gas production facilities. It is possible that new oil and gas discoveries will be made in the project area in the future. However, the Corps' policy is to allow exploration and production within a project area as long as any structures and/or levees are not endangered. To insure this condition, a permit must be secured from the Corps and a definite set of restrictions adhered to.

Comment: "We believe that the lignite and clays of the area are uneconomic and that the project will not significantly alter the availability of sand and gravel or stone. Pipelines in the area are noted, and the document states that they will be relocated."

Response: Noted.

Comment: "We agree that faults in the area apparently are inactive, having shown no recent movement. Still, we believe that the final version of the document should discuss in more detail possible effects of the faults on the reservoir."

Response: The faults at the damsite are judged to be inactive mainly due to the fact that they apparently do not cut nor displace Pleistocene age sediments. The faulted material (of Tertiary and Cretaceous ages) is composed predominantly of very fine grained impervious shale and clays with only occasional lenses of finely granular materials (sands and silts). The "gouge zones" associated with individual faults should be at least as tight and impervious as the sediments themselves. The possibility of significant seepage along these faults is negligible.

Likewise, induced slippage due to lubrication of the faults as the reservoir fills is also improbable due to the impermeable nature of the surface sediments.

Finally, the subsurface faults at the damsite are the result of differential compaction and gravity sliding associated with the

formation of the Gulf Coast Geosyncline. Movements along these faults may occur in the future, but since the sediments are relatively soft and incompetent, the movements could not generate damaging earthquakes nor could the sediments transmit significant shock waves from distant or deep-seated sources.

(10) FEDERAL POWER COMMISSION (1 September 1976)

Comment: "The Federal Power Commission has previously considered the hydroeletric power potential of the Cooper Lake project. In its letter of September 27, 1968, to the Secretary of the Army, the Commission concluded that the proposed Cooper project would not provide opportunity for the economical development of hydroelectric power."

Response: Noted.

Comment: "The draft statement indicates that relocations would be required for a number of electric power transmission lines, electric power distribution lines, and natural gas pipelines. The relocation of these facilities should be conducted in such a manner as to minimize any disruption of service."

Response: The relocation of these facilities will be conducted in such a manner as to minimize any disruption in service.

b. State agencies

(1) LOUISIANA DEPARTMENT OF PUBLIC WORKS (29 June 1976)

Comment: "This department has reviewed the draft environmental statement for the authorized project, Cooper Lake and Channels, Texas. It appears that the environmental appraisals and concerns for the project are well documented and presented. We have no comments to submit concerning the report."

Response: Noted.

(2) ARKANSAS DEPARTMENT OF LOCAL SERVICES (30 August 1976)

(a) ARKANSAS GAME AND FISH COMMISSION

Comment: "I would reiterate earlier recommendations of the U. S. Fish and Wildlife Service as concurred in by the Arkansas Game and Fish Commission for minimum downstream flows from Lake

Texarkana in view of the importance of the Sulphur River Wildlife Management Area and integral waterways to the state's resident wildlife and fisheries resources, to migratory waterfowl and to the American alligator, an endangered species."

Response: See response to USDI comments on pages IX-24 and IX-31.

(b) ARKANSAS HISTORIC PRESERVATION PROGRAM

Comment: "The professional staff of the Arkansas Historic Preservation Program has reviewed the available material which pertains to the area in question. The staff of the Historic Preservation Program has reported that the proposed Cooper Lake and Channels project will not affect any property of architectural or historical significance."

Response: Noted.

(3) GOVERNOR OF TEXAS (14 December 1976)

Comment: "The findings of the draft document confirm and complement the technical feasibility determination made by the Texas Water Rights Commission in the issuance of water rights permits for this project. The Texas Water Development Board strongly supports this project and urges that it be developed as soon as possible to meet the future water needs of this important region of the State. The Board has stated that the overall benefits from the implementation of this project will far outweight any possible adverse effects.

"As Governor of the State of Texas, I am committed to the effective development of the water resources of the river basins and watersheds of this State. The Texas comprehensive program for water resource development is designed to meet anticipated needs, and Cooper Lake is a designated project in the Short Range Plan of this program. Cooper Lake is a multi-purpose project that will provide not only essential water resources for the Sulphur River and the North Texas Municipal Water Districts and the City of Irving, but it will also reduce the threat of flooding in the Sulphur River Basin.

"This important water resource development project has the full approval of the State of Texas. It is my position as Governor and it is the position of the State of Texas that this urgently needed water supply and flood control project should be carried to completion at the earliest possible date."

Response: Noted.

c. Environmental groups

(1) ENVIRONMENTAL DEFENSE FUND (29 June 1976)

Comment: "First, the draft EIS discloses that at the very least 2,560 acres of bottomland hardwoods will be cleared and destroyed as a result of the project. We anticipate that, in fact, as a result of construction, maintenance and operation of the project and secondary hydrologic impacts, thousands of other acres of bottomland hardwoods will be adversely affected. This destruction of bottomland hardwood is contrary not only to substantive policies of NEPA but to Corps wetland policies as enunciated in 33 U.S.C. §209.145(e) (3), issued pursuant to 33 U.S.C. §1344.

"This is only one of numerous Corps of Engineers civil works projects in the southeast, the delta states and southwest of the United States which are systematically destroying, directly or through secondary impacts, hundreds of thousands of acres of bottomland hardwoods. Not one of these impact statements addresses the cumulative effect of all of these Corps of Engineers projects on bottomland hardwoods. Until the Corps of Engineers prepares a program impact statement evaluating the impact of its various programs on wetlands throughout the United States, each individual impact statement must address and evaluate the cumulative effects on bottomland hardwoods and other forms of wetlands of the individual project in question and other projects elsewhere. This kind of cumulative impact analysis is required by 33 U.S.C. §209.145(e) (3)(iii). It is also required by NEPA. The bottomland hardwood and wetland renewable resource base of the southern part of the country is gradually being destroyed by a variety of human activities most of which are under the direct or permit control of the Corps of Engineers."

Response: Examination of table IV-5 on page IV-23 of the draft EIS, in fact, disclosed that approximately 9,280 acres of bottomland hardwoods would be cleared. With the selected plan, as addressed in the statement, this total increases to 9,520 acres.

The preparation of "regional" environmental impact statements--whatever the theoretical benefits thereof--would, in today's planning milieu, involve insurmountable practical difficulties. The preparation of statements on individual actions is a workable approach, which will yield adequate results provided that all significant interactions between individual proposals are identified

and the corresponding impacts, whether direct or indirect, are described. In our view, this has been accomplished in this statement.

It is recognized that the law favors comprehensive environmental impact statements in certain cases. However, the geographical area for such a study is left to the agency's judgement, based on such factors as feasibility. It is felt that as long as cumulative effects are adequately addressed in individual EIS's that compliance with the law has been accomplished. The southwest, delta states, and southwest areas that are suggested as appropriate for a regional EIS are, in the view of this office, cumulatively beyond the stage of the art for EIS preparation. Such a study would probably not yield any timely or usable information.

Comment: "Second, the draft EIS indicates that at least 78 miles of natural river will be realigned and channelized. Channelization of rivers inevitably results in the destruction of water based habitat and also the degradation of water quality. This has been demonstrated in any number of studies. Inevitably, channelization increases turbidity, erosion and downstream siltation. Furthermore, secondary impacts from changing uses of the water resources in question inevitably result in the degradation and pollution of affected water resources and water quality. These water quality impacts should be assessed and evaluated in view of the standards developed in the 1972 Federal Water Pollution Control Act Amendments. Specifically, Section 313 of that Act, 33 U.S.C. §1323 provides that federal installations must 'comply with federal, state, interstate and local requirements respecting control and abatement of pollution to the same extent that any person is subject to such requirements.' Federal, state and local pollution control requirements are set forth in state water quality standards developed under 33 U.S.C. §1313(c), EPA Interim Drinking Water Standards developed under the Safe Drinking Water Act, basin plans developed under 33 U.S.C. §1313(e) and areawide waste treatment management plans being prepared under 33 U.S.C. §1288. Thus, the EIS should evaluate the water resource and water quality impacts of the project in light of these standards, policies and plans."

Response: It is acknowledged that channelization of the Sulphur River will result in the destruction of water based habitat and also the degradation of water quality by temporarily increasing turbidity, erosion and downstream siltation; however, as noted in Section 1, an alternative plan which eliminates nearly 80 percent of the remaining channel realinement has been selected. Impacts on water quality were addressed in sections 4 and 5 of the draft EIS as well as elaborated upon further in responses to the

United States Department of the Interior and US Environmental Protection Agency in the comments section of this final EIS. In addition to the preceding impacts, data obtained in the 303(e) Water Quality Management Plan for the Sulphur Basin indicates that high sulfate values in the North Sulphur River are a direct result of the stream channelization that has already occurred there. These sulfate values exceed the State of Texas' criteria of 100 mg/l. Sulfate data in the Sulphur River between Cooper and Wright Patman Lakes are well within state criteria.

It can therefore be suggested that as a result of channelizing the Sulphur River between Cooper and Wright Patman Lakes, state water quality criteria for sulfates may be violated. It is not inevitable, however, that secondary impacts from changing uses of the water resources in question inevitably will result in the degradation and pollution of affected water resources and water quality. In fact, the 1972 Federal Water Pollution Control Act Amendment (Public Law 92-500) referenced in the above comment provides the necessary tools to improve the water quality of the project area in spite of an increase in the changing uses of the water in question as a result of implementation of the project. Section 313 of PL 92-500 does require Federal installations to comply with Federal, state, interstate, and local pollution requirements. However, precautions will be taken in order to minimize the amounts of water, air, and solid waste pollutants generated during construction of the project. Expected water quality during and after construction was discussed, with the exception of the sulphate problem, in section 2 of the draft EIS. The major water quality parameter to be affected by the project is an increase in suspended solids entering Wright Patman Lake. This has been estimated to be on the order of magnitude of less than a 2 percent increase. Maximum allowable concentrations for suspended solids in the Sulphur River have not been established by either the Texas Water Quality Board, the EPA, or local interests. Once the project is completed and functional, it will be the responsiblity of local, state, and Federal pollution agencies to enforce water quality regulations promulgated under PL 92-500.

The water quality and water quality impacts of the project were discussed in light of both state water quality standards and EPA Interim Drinking Water Standards in Sections 2 and 4 of the draft EIS with the exception of the possible violation of state water quality criteria for sulfates resulting from the limited channelization between Cooper and Wright Patman Lakes. The construction of Cooper Lake has been included as an integral part of the 303(e) Water Quality Management Plan for the Sulphur River Basin. It is noted in this basin plan that the programmed low-flow

augmentation release from Cooper Reservoir of 5.0 c.f.s. will help maintain a minimum water flow downstream in the Sulphur River where now there is sometimes zero flow. This zero flow and accompanying low dissolved oxygen concentration prompted the Texas Water Quality Board to classify this segment of the Sulphur River as a water quality limited stream subject to waste load allocations of its point source discharges. The 5.0 c.f.s. flow from Cooper should help to alleviate this problem. The ARK-LA-TEX Council of Governments presently has a 208 area-wide waste treatment management plan for the area in and around Texarkana, Arkansas. However, the Sulphur River Basin in the area of Cooper Lake is not a part of this 208 plan.

Comment: "Third, the project is designed to provide 30 year flood protection to certain areas. This objective of the project does not appear to be compatible with the purposes of the 1973 Flood Disaster Protection Act and regulations issued thereunder. A full discussion of the impact of this project on the participation of any communities in the relevant area in the Federal Flood Insurance Program and implementation of reasonable local land use ordinances designed to implement the policies of the Flood Disaster Protection Act should be fully discussed and evaluated."

Response: It is the policy of the Corps of Engineers to consider in the planning process all practicable and relevant alternatives applicable to sound flood plain management. Positive actions are of two kinds: namely measures to modify floods, and measures to modify damage susceptibility.

Measures to modify floods generally include dams and reservoirs, levees and channels, and other structural means which function physically to reduce the frequency of damaging floods. Measures to modify damage susceptibility include flood forecasting and warning systems, temporary or permanent evacuation and relocation, flood fighting and financial relief, land use regulations including floodway delineation, flood plain zoning, flood insurance programs and other similar nonstructural measures, exclusive of control of flood waters. These latter measures seek to reduce future susceptibility to flood hazards and damages consistent with the exposure involved, and, accordingly, are appropriate solutions to flood damage prevention when it can be shown that land use controls are essential to a sound solution of the flood hazard problem and proper future operation of the project.

The Corps policy in design of flood control projects is to provide an optimum degree of protection consistent with safety of life and property, acceptable residual hazards and costs. The

Corps seeks an economically/environmentally efficient degree of protection and land use in agricultural areas, and acceptable reduction of risks and preservation of environmental values in protecting other rural and urban areas.

Regulation of flood plain use and development by the responsible local public entity may, where practicable, be specified as a required condition of local cooperation to achieve overall plan objectives most efficiently and to protect any specified Federal investment feature from adverse effects of encroachment in the flood plain area.

The Corps cannot ordinarily require flood plain regulation of non-Federal entities. However, the Corps may require such regulation in a particular problem area. Such requirements are defined to be consistent with the flood protection provided and the remaining flood hazard.

A National Flood Insurance Program is available to protect individuals in concerned communities from disaster in the event of a flood. Insurance by definition is economically inefficient because it reimburses for a loss, but does not normally prevent the loss. The current flood insurance laws make it reasonable to assume that all communities having "special flood hazard areas" will ultimately come under the National Flood Insurance Program.

The Flood Disaster Protection Act of 1973 increases limits of coverage authorized under the flood insurance program; provides for accelerated identification of flood risk zones; requires states or local communities, as a condition of future Federal financial assistance, to participate in the flood insurance program; requires the purchase of flood insurance by property owners who are being Federally assisted in the acquisition/improvement of land in flood hazard areas; and extends the flood insurance program to cover losses from the erosion and undermining of shorelines by waves or currents.

The provision of 30-year flood protection by structural means in a predominantly agricultural area is not inconsistent with either the Flood Insurance program or the Flood Disaster Protection Act. Nonstructural means for modifying damage susceptibility have their most practical applications in urban or rural areas which pose particular flood hazard problems. The character of the Sulphur River basin below the proposed reservoir is agricultural and presents no such particular flood hazards to habitable residences as would warrant the implementation of a nonstructural alternative.

(2) OZARK SOCIETY, BAYOU CHAPTER (29 July 1976)

Comment: "The DEIS does not give any evidence of the need for more areas of recreation in northeast Texas. Since the Wright Patman Lake is so close we would have to question the actual (not potential) use that any additional reservoir in the area would receive."

Response: The bulk of the demand for Cooper Reservoir recreation will come from the Dallas-Fort Worth areas. Wright Patman Lake is considerably farther from the Dallas-Fort Worth metro area than Cooper Reservoir and, therefore, is not a viable competitor for weekend outdoor recreation demand. Data from the Texas Parks and Wildlife Department (tables II-16 through II-21) indicate that recreation requirements for the Cooper Lake area exist through the year 1990.

Comment: "Furthermore, the unloading of large amounts of sediment in Wright Patman Lake would surely decrease its desirability as a recreation facility, as well as its use in water supply."

Response: Recreation conditions at Wright Patman Lake are not expected to be affected by the relatively small amount of sediment induced by the channel excavation proposed in the selected plan.

Comment: "As stated in the DEIS, public access to the river prevents its use in recreation now. This problem could be easily and cheaply solved by purchasing a few tracts accessible to the public and designating them for recreational uses."

Response: Noted; however, in order to serve the best interests of the entire local population, a plan has been selected which is wholly responsive to other indicated needs of the area including recreation.

Comment: "Another worthwhile objective of the project listed in the DEIS is flood control. However, we cannot justify flooding 19000 acres in order to protect 12900 acres."

Response: The water supply pool in the reservoir will inundate a surface area of approximately 19,305 acres below elevation 440.0 m.s.l. The water supply pool is not dedicated to the purpose of flood control. The reservoir contains a specific flood control pool between elevations 440.0 and 446.2. This pool will inundate approximately 22,740 surface acres at elevation 446.2. It will contain a total storage of 131,400 acre-feet exclusively for

flood control. In actuality, about 3,435 acres (22,740 minus 19,305) will be intermittently flooded to afford a 30-year level of flood protection to approximately 12,900 acres of lands below the reservoir.

Comment: "Furthermore, periodic flooding is important in furnishing nutrients to the soil. Flooding is just one of nature's tools that is essential for the continued productivity of the soil. Farmers of this area, with the proper guidance, could use the enrichment of the soil by flooding to their advantage."

Response: While it is recognized that periodic flooding provides nourishment to inundated soils, it is equally important to recognize that the flood losses sustained by the farmer under such conditions far outweigh the additional natural productivity of the soil during nonflood periods. Furthermore the irregularity of flooding within the study area would seriously weaken the effectiveness of an agricultural plan designed to advantageously utilize such natural enrichment of the soil.

Comment: "The DEIS also states that the channelization of the Sulphur River will have a disastrous impact on the stream ecosystem. The increased agricultural activity will result in increased levels of insecticides, herbicides, and fertilizers in the aquatic ecosystem. Increased erosion resulting from clearing the land will also occur. The combined effect of more siltation, insecticides, herbicides, etc. will surely result in more deleterious effects on Lake Wright Patman. Adopting this proposal would be grossly unfair to those people dependent on Lake Wright Patman for their water supply."

Response: The channelization of the Sulphur River will have a severe impact on the stream ecosystem as is pointed out in Section 4 of the EIS; however, the extent of channelization has been greatly reduced by the selection of the alternative plan described in Section 1. The increased agricultural activity could result in increased levels of insecticides, herbicides, and fertilizers in the aquatic ecosystem if the increased agricultural activity was of the crop production type. However, as is pointed out on pages II-86 of the EIS, agricultural emphasis in the study area is in the production of livestock and livestock products as evidenced by the large amount of acreage devoted to pasture. Increased agricultural activity resulting from the Cooper Reservoir project is expected to be predominately of the pasture type. Consequently, increases in insecticides, herbicides, and fertilizers are expected to be minor. The effect of increased siltation of Wright Patman Lake has been discussed in response to a similar

comment by the United States Environmental Protection Agency on page IX-12.

Comment: "The only possible advantage to this project would be the establishment of a permanent water supply. We suggest that the need of such a water supply be quantified, and then alternative methods taken to meet this need."

Response: The project is fully justified as a multi-purpose development to satisfy the purposes of not only municipal and industrial water supply, but also flood control and recreation. Unquestionably, the regional need and desire for water supply is demonstrated by the fact that all of the 273,000 acre-feet of water supply storage space included in the lake has been contracted for purchase by local water supply entities. Further, surface impoundment storage is the only practical local supply source due to both the poor groundwater sources and seasonal deficiencies in natural streamflows in the Sulphur River Basin. Alternatives that were considered to meet the water resource needs are presented in Section 6.

Comment: "In summary, The Conservation Committee of the Bayou Chapter (Ozark Society) is opposed to the Cooper Lake and Channels, Texas, project."

Response: Noted.

Comment: "The need for the reservoir and channelization of the Sulphur River has not been quantified, and as we have pointed out, the disadvantages of this proposal far outweigh any advantages it may have."

Response: Basic information on project formulation is provided in House Document No. 488, 82nd Congress, 2nd Session dated 3 August 1954 which is a matter of public record.

Comment: "Furthermore, although this proposal may solve some of the problems of the residents of this area, it will create a multitude of problems for the residents dependent on Lake Wright Patman for their water supply."

Response: As indicated in response to a similar comment by EPA on page IX-12, the impacts of the currently proposed plan on water supply at Wright Patman Lake will be negligible.

Comment: "Therefore, we request that a suitable alternative be considered that would not result in a structural modification of the Sulphur River."

Response: A full range of suitable nonstructural as well as structural alternatives for flood control along the Sulphur River have been considered and evaluated in the environmental statement and plan selection process.

(3) TEXAS COMMITTEE ON NATURAL RESOURCES (31 July 1976)

Comments by this committee noted the following "Omission from Statement."

Comment: [Omission] "System-wide impacts (except that the statement does touch lightly upon the siltation which the channel would cause in Lake Wright Patman)."

Response: A discussion of system-wide impacts necessarily depends upon the definitive identification of the particular system to be analyzed. The EIS generally assesses direct and indirect impacts from the proposed action that are generated within the Sulphur River Basin above Wright Patman Lake. The impacts of the project on Wright Patman Lake have been identified to the extent that the proposed action directly or indirectly affects that lake; i.e. the introduction of suspended solids, turbidity, higher treatment costs, etc. However, the impacts associated with the possible conversion of flood control storage space at Wright Patman Lake permitted by the Cooper authorization have not been fully assessed since the conversion in Wright Patman Lake is not a necessary consequence of the Cooper project. Accordingly, the identification and analysis of the impacts associated with the conversion of Wright Patman Lake will be fully disclosed in a separate environmental statement addressing that action. Refer to paragraph 1.06 on page I-14 for additional information.

Comment: [Omission] "Harmful effects on the estuary at the Gulf of Mexico."

Response: Estuaries are among the most biologically productive areas known to man. Structures that eliminate or reduce freshwater input into an estuary can be extremely detrimental at times.

The Sulphur River flows into the Red River which, in turn, empties into the Atchafalaya River drainage system. The mean annual flow of the Sulphur River into the Red River prior to the construction of Wright Patman Dam was approximately 3,300 cubic feet per second (c.f.s.). Construction of Wright Patman Dam reduced the mean annual flow to approximately 2,900 c.f.s. The maximum impact attributable to Cooper Lake would be the complete

elimination of flow from the South Sulphur River above the damsite - an average annual flow of 340 c.f.s.

The combined effects of these two dams would be an estimated reduction in the average annual flow of the Sulphur River by 740 c.f.s. When compared to the average annual flow (150,300 c.f.s.) of the Atchafalaya River at Simmesport, Louisiana, it may be noted the reduction in flow caused by the two dams is less than 0.5 percent of the total flow at that point. There is no estuarine area that is particularly dependent upon the freshwater flow affected by the selected plan.

Comment: [Omission] "Net energy loss, including from construction and maintenance of the dam and channel."

Response: It would be a task far beyond reasonable expectation to account for quantum energy losses associated with the performance of various tasks outside of controlled laboratory conditions. In a more realistic context, it may be presumed that the commercial availability of energy resources for construction and/or maintenance activities, be they human or natural, indicates a voluntary or economically motivated desire that such resources be committed upon just compensation. Energy losses associated with labor and material are reflected by the costs to procure such supplies, and these costs are in turn directly reflected in cost estimates for various project activities. In the theoretical sense, of course, this form of incipient energy will be irretrievably and irreversibly lost in its conversion to substantive byproducts.

Comment: [Omission] "Effect of the channel in lowering the water table."

Response: Recharge of ground water occurs during wet periods when both rain over the whole area and water from higher flood levels of the stream enter the soil. Deepening the channel has no appreciable effect in increasing the rate of soil water drainage toward the stream. As flood levels are lowered as a result of channelization, the recharge of the soil in the immediate area can be expected to decrease somewhat. However, recharge resulting from rainfall will still enter the soil at the same rate. Additionally, there will still remain sump storage areas adjacent to the landside of the levee system that will help maintain recharge of the water table. Inspection of the channelized portions of North Sulphur River indicates that vegetation and trees continue to grow right up to the banks of the stream indicating that soil moisture has not been depleted by the channels.

Comment: [Omission] "Deprivation of the floodplain soil from periodic enrichment which occurs so long as floods continue bringing nutrients."

Response: Flooding plays a complex role in the nutrient cycle of a bottomland forest--adding to and taking away. Undoubtedly nutrients are carried in the sediment-laden waters. Much of this sediment passes through the flood plain, but some is deposited as well. Therefore, we agree that flooding is a source of nutrient input to a flood plain forest. One aspect frequently overlooked, however, is that flooding removes much of the litter crop returned to the soil surface each year. This is transported out of the site and is concentrated in interception areas (i.e., logs and brush) or is accumulated in slow water areas, such as pools and lakes. Probably this loss is less than flooding inputs, but valid data are not available to evaluate the magnitude.

Another important aspect of flooding is the recharge of soil moisture reserves. Broadfoot (1967) and Broadfoot and Williston (1973) document benefits and damages wrought by flooding of bottomland forests. They note that flood-resistant hardwoods are damaged where silt and sand are deposited to depths of three or more inches, where soil conditions are adverse, and in small depressions where water does not leave promptly. In these areas, mortality can occur within four years. Seedling mortality of resistant species is similarly affected in such areas. Prolonged flooding may result in toxic levels of certain soil nutrients, although such conditions are not common in frequently flooded natural stream systems. As indicated in a comment by the US Forest Service on page IX-6, "the flora and fauna of the bottomlands have evolved and adapted to present conditions of periodic flooding over eons of time." While it may be true that periodic flood overflows enrich the soils, nevertheless, the benefits of such enrichment can not be derived when sustained agricultural production and output is foreclosed or impaired by that inundation.

Comment: [Omission] "Losses of water through evaporation from the reservoir and the open, unshaded channel."

Response: Rainfall on the lake surface will help offset lake evaporation. Net evaporation losses were developed for the period 1924 through 1963 in an effort to consider its effect on the water supply yield of the lake. The average annual net reservoir loss during this 40-year period was 1.88 ft. Maximum and minimum values varied from 4.01 ft. in 1956 to 0.23 ft. in 1957, respectively. Channelization, although limited in the selected plan, will confine a greater percentage of flows to the channel

thereby reducing the water surface area available for evaporation. The net effect of channel improvement has not been quantified, but its effect on evaporation within the basin is considered to be negligible.

Comment: [Omission] "Costs of the projected growth to be caused by damming and channelization, including increased costs of water treatment, sewage and solid waste disposal, air and water pollution control, law enforcement, crime, urban blight, education, public welfare, hospitalization, etc."

Response: There would be some induced urbanization and recreation visitation as a result of the proposed plan, and thus, attendant growths in urban problems, public services, and public facilities. However, this effect would be moderate due to the size and location of that growth, and the accompanying increase in public revenues.

Reservoirs located in rural areas, such as Cooper, historically have not spawned intensive types of urban development, contrary to the expectations of many rural residents and supporters of reservoir development. The rate of conversion of rural land from production uses to consumption uses is largely dependent on the state of the general economy and is a trend that began some 30 years ago in Texas. Increased costs of public services resulting from consumption land use ownership largely will be offset by the increased tax revenues.

Public and private-lease recreation facilities located on and near the water are required to adhere to Federal standards concerning air, water, and other types of pollution.

Comment: [Omission] "The alternative of a plan which utilizes more than one of the non-structural floodplain management elements of zoning, acquisition flood warning, agricultural education, etc. in the various stretches of the river at various access points."

Response: This comment suggests the display of a combination of alternatives presented in the environmental statement. The alternatives presented fall within the broad category of nonstructural alternatives, and the evaluation of nonstructural measures to satisfy project objectives is applicable in principle to any alternative plans within that category. An alternative of a plan which utilizes more than one element of nonstructural measures merely represents a combination of the plans included in the EIS,

AD-A100 099   ARMY ENGINEER DISTRICT NEW ORLEANS LA   F/G 13/2
COOPER LAKE AND CHANNELS, TEXAS.(U)
APR 77

UNCLASSIFIED   NL

4 of 5
AD
A100099

and the advantages or disadvantages of such a plan can be extrapolated from the data included for the plans presented.

Comment: [Omission] "The alternatives which would manage floods of 100 year frequency rather than merely 30 year frequency."

Response: A discussion of flood frequency selection has been added on page VI-37.

Comment: [Omission] "The alternative of a strictly water supply reservoir and no channelization or other flood control structures."

Response: The Corps has not failed to consider a strictly water supply reservoir. It should be recognized, however, that an immediate distinction between mere consideration of such an alternative and the premise that such an alternative constitutes a viable Federal alternative solution to the purposes for which the project was authorized. Each of the alternatives presented in the EIS ostensibly comports with a recognizable Federal purpose in water resources development.

National water resources policy, as defined by Congress, has been developed over a number of years and is still being clarified and extended by legislation. The policy recognizes a significant Federal interest in the long-range management of water supplies, but generally assigns the financial burden of that supply to the user.

Municipal and industrial water supply is considered the primary responsibility of the municipal or other non-Federal entities. However, water supply storage space may be recommended for inclusion in any Corps reservoir pursuant to the Water Supply Act of 1958 (Public Law 500, 85th Congress, Title III), as amended. The pertinent provision of that enactment is as follows:

> "(a) It is declared to be the policy of the Congress to recognize the primary responsibility of the States and local interests in developing water supplies for domestic, municipal, industrial, and other purposes and that the Federal Government should participate and cooperate with States and local interests in developing such water supplies in connection with the construction, maintenance, and operation of Federal navigation, flood control, irrigation or multiple purpose projects."

The inclusion of water supply storage in the project is supplemental to the development of a flood control program for the basin and in concert with multipurpose water resources policy.

Notwithstanding the fact that a distinct and separate alternative contemplating the development of a water supply only reservoir has not been included in the EIS, the issue remains as to whether or not the impacts of such an alternative can be ascertained from the data that is included in the statement. In this regard, several factors should be elucidated. First, the EIS does include an alternative for a "reservoir only." This alternative, comprehends essentially a reservoir that includes a permanent water supply pool (273,000 acre-feet), a flood control pool (131,400 acre-feet), and a sedimentation pool (37,000 acre-feet). The data presented in the environmental statement clearly distinguishes the effects of the permanent inundation of 19,300 surface acres below elevation 440.0 feet m.s.l. (the area below the normal water supply pool) and the impacts associated with the periodic inundation of the lands between elevations 440.0 and 446.2 (the flood control pool). The 37,000 acre-foot sedimentation pool may be assumed to be required irrespective of whether the reservoir is to accommodate a water supply only purpose or multiple purposes. From the data thus presented, the impacts expected from the development of a water supply only reservoir which includes 273,000 acre-feet of storage below elevation 440.0 feet m.s.l. can be extrapolated.

Comment: [Omission] "The nature and effect of land ownership and habitation patterns."

Response: Any significant alteration of land ownership or habitation patterns due to the proposed plan would occur near lands currently devoted to urbanization. There would be no effect on such patterns within the existing flood plain. Thus, the project would have minor adverse impacts on desirable community growth patterns within the study area.

Comments by the Texas Committee on Natural Resources noted the following "Inadequacies of Statement."

Comment: [Inadequacy] "The discussion of erosion and siltation fails to cite specific locations, causes and values, and fails to contrast structural and non-structural effects."

Response: The environmental statement indicates that channel improvements have been accomplished by local interests and by the Federal Government in various reaches of streams in the Sulphur River watershed. This channel work has resulted in steeper

channel gradients, higher flow velocities and streambed erosion which enlarges the cross-sectional area of those streams. These conditions prevail for many years until an equilibrium is established. The material washed away in the channel enlargement process is transported downstream until stream velocities subside to the point where the stream is no longer capable of conveying a large sediment load. In areas where channel improvement was not accomplished, the stream is incapable of transporting suspended sediments and deposition occurs. This effect is most noticeable in the vicinity of the Highway 37 crossing of the Sulphur River, due to the fact that channel improvement was not completed below that crossing. Several of the structural alternative plans include provisions to rectify this condition by additional channel improvements. This condition will probably persist with the selected plan; however, since with this plan, effective channelization does not begin for a distance of approximately 10 miles downstream from the Highway 37 crossing.

Comment: [Inadequacy] "The statement fails to explain how the loss of 19900 acres of wildlife habitat in the reservoir site would be mitigated by acquiring 1200 acres of periodically inundated lake shore."

Response: The Corps' position on mitigation is discussed in Section 4.02c(3)(b) on page IV-35 and Section 5.07b(4) on page V-4.

Comment: [Inadequacy] "The statement fails to state what mitigation acquisition is required to offset losses of habitat to be caused by proposed channelization, and to describe these losses."

Response: See response to previous comment on page IX-50. Pages IV-26 through IV-33 are dedicated to describing the losses induced by the levees and the rather limited channelization that are now proposed in the selected plan (Section 1).

Comment: [Inadequacy] "The statement fails to evaluate the construction costs necessary to offset the sedimentation which the channel would cause in Lake Wright Patman, and to assess the environmental costs of such sedimentation."

Response: No direct construction costs associated with sedimentation removal in Wright Patman Lake have been computed due to the fact that it is not intended to remove these deposits from the lake. The transported sediments are expected to be deposited in the headwater regions of the lake within the flood control storage pool. The ultimate encroachment on the flood control

storage capacity caused by the sedimentation is considered to be insignificant (less than 1.0 percent of storage capacity) due to the large amount of storage capacity (2,509,000 acre-feet) that presently exists in Wright Patman Lake, and accordingly, there will be an insignificant change in operational lake levels after such deposition occurs. Since these deposits would not significantly affect the regulation of lake levels or operation of structural features of the lake, future removal is not contemplated.

As indicated in response to a similar comment by EPA on page IX-12, the environmental effects of the increased sedimentation are negligible.

Comment: [Inadequacy] "The statement fails to describe and explain the erosion and siltation damages caused by channels and levees already constructed in the Sulphur River and tributaries and to consider the devastating effects of these structural features."

Response: Channel improvements implemented in connection with the Cooper project or those initiated by local interests have resulted in a reduction of overall channel lengths and steeper channel gradients. Steeper gradients result in quicker runoff, higher stream velocities, and channel erosion. These effects increase the need for adequately protecting bridge abutments at channel crossings, and also impose an increased burden on the ability of unimproved channel reaches to convey discharges and sediments. Flow velocity reductions at unimproved channel locations result in sediment deposition, trash and debris accumulation, and overbank flooding. The effects described above, however, are not wholly assignable to the improvements that have been accomplished to date. These are more properly attributed to the unimproved status of remaining stream reaches. Completion of the project as described in the draft EIS would have ameliorated these harmful effects; however, an alternative plan (see Section 1) has been selected which eliminates 80 percent of the remaining channels in an effort to preserve the existing natural aquatic environment.

Comment: [Inadequacy] "The statement placing the responsibility of levees on local interests fails to consider in this connection the fact, stated on a different page, that the local interests have not maintained adequately the existing levees."

Response: The responsibility for levee maintenance is a legislated requirement accepted in principle by local interests when they request that a study be made by an agency of the Federal Government of the possibility of including the levee in a Federally funded flood control project. In the absence of a complete

functioning flood control project, typified by this project which has been long deferred, little incentive exists, in a practical sense, for local interests to provide other than minimal maintenance or emergency repairs. Local interests are not bound to provide full interim maintenance for features of a nonfunctional flood control project that is dependent on completeness of all elements for effective function. The Corps of Engineers lacks legislative authority to perform other than emergency maintenance (repairs) on an incomplete project; emergency repairs have been made as needed at critical locations. Upon completion of the project a maintenance and operation manual will be developed by the Corps of Engineers; it will include recommendations, options, and requirements for levee protection, maintenance, and repair. The manual will be a part of the necessary local cooperation agreement with the involved Texas county commissions.

Comment: [Inadequacy] "The statement fails to quantify the wildlife losses from inundation and channelization."

Response: Quantified project induced wildlife and fishery losses are displayed in table IV-4 on page IV-22. Those estimates do include losses from inundation, in the case of those alternatives with a reservoir, and from channelization, in the case of those alternatives with a channel.

Comment: [Inadequacy] "In discussing recreational attractions, the statement fails to confront the question of how many potential users would be attracted away from nearby lakes already constructed or being planned, and what effect this competition would have upon the benefit/cost ratios of those lakes."

Response: See response to USDI comment on page IX-25.

Comment: [Inadequacy] "The statement refers to an Ark-Tex COG study which should be completed in the near future, including land use information for the Cooper Lake area, but reflects no effort to obtain or to report preliminary drafts of that study."

Response: In a telephone conversation on 9 September 1976, Mr. Todd Brown, Director of Regional Planning for the Ark-Tex Council of Governments, indicated that although the referenced water quality management study, paragraph 3.01 c(1) on page III-1, has been completed, it does not contain specific land use information for the Cooper Lake area. Mr. Brown said that such information will be addressed in a resource management plan which will probably be released in late 1976 or early 1977.

Comment: [Inadequacy] "The statement refers to an Ark-Tex COG comprehensive open space plan proposing that the Cooper Lake and Channels area be left either a natural or undeveloped state. Yet the statement in no way elaborates nor gives reasons why the Ark-Tex plan is right or wrong."

Response: In the telephone conversation referenced in preceding comment, Mr. Brown indicated that their proposal (that the Cooper Lake and Channels project area be left in either a natural or undeveloped state) is accurate only in the sense that they recommend that the area be reserved for public usage. He further indicated that Cooper Lake and its proposed recreation facilities are certainly in harmony with the Ark-Tex Plan for development of the recreational resources of the Sulphur River Basin. To that extent, no conflict between the Corps proposal and the Ark-Tex Plan is perceived.

Comments by the Texas Committee on Natural Resources noted the following "Inaccuracies of Statement."

Comment: [Inaccuracy] "The statement refers to benefits of ox-bow lakes which would be cut off, but fails to show that such ox-bows would silt up and eutrophy in a short time."

Response: Eutrophication is a natural aging process in all lentic communities. There is never any question therefore as to whether a lake, pond, or oxbow will eutrophy. The only question concerns the speed at which eutrophication will proceed. Unfortunately, data are not available on which to base reliable predictions of eutrophication rates in oxbows within the Sulphur River drainage basin.

Comment: [Inaccuracy] "The project claims recreation benefits from oxbows but this is impossible because the statement rejects providing public access."

Response: All benefits claimed are an estimate of recreation potential based on present accessibility. In other words, the oxbows will yield that level of recreation benefit with the limited access presently available.

Comment: [Inaccuracy] "The statement says the reservoir would protect 3200 acres of bottomland hardwood forest downstream but fails to state that the projected cessation of flooding would actually deprive the forest of nutrients and water and would thereby eventually kill it, rather than protect it."

Response: More accurately, the statement says that the reservoir will provide flood protection to 3,200 acres of bottomland hardwoods below the dam (see page IV-19). The statement also clearly indicates that some 80 percent of that total would be lost to induced clearing. Accordingly, this is not measured as a benefit to wildlife populations.

Comment: [Inaccuracy] "The statement distorts the annual benefits of structural flood control alternatives and showing zero or minimal annual benefits to non-structural, which also reduce flood damages, although in a different way, and which, in other Army Corps projects, have been found to be more cost effective."

Response: An analysis of various flood plain management plans has been completed and is shown in Section 6.02 (Non-structural alternatives to the Proposed Action) of this document. Information on additional analyses is available in another planning document, "Alternative Plan Studies," which is on file at the New Orleans District office.

Comment: [Inaccuracy] "The statement distorts the purposes of the National Flood Insurance Program and its applicability."

Response: The program established by Congress in the National Flood Insurance Act of 1968 and expanded in the Flood Disaster Protection Act of 1973 is designed to provide flood insurance at rates made affordable through a Federal subsidy. In return, communities must adopt and administer local measures that protect lives and new construction from future flooding. It is not the intent of the act to exclude flood protection by structural methods where such methods are economically justified.

For additional discussion, see response to Environmental Defense Fund comment on page IX-39.

Comment: [Inaccuracy] "While the statement contends that floodplain zoning results in possible relocation, there are, in fact, no houses or buildings in the floodplain, so there are none to relocate."

Response: The statement in the EIS that "flood plain zoning could result in the possible relocation of existing improvements that are incompatible with the zoning provisions as well as foreclosing the possibility of future developments, likewise incompatible, which might have occurred in the absence of such regulation" is correct as stated. In stating that "there are, in fact, no houses or buildings in the flood plain, so there are none to

relocate," the commenting agency has apparently misinterpreted what was stated in the EIS. First, the statement is not restrictive to only houses and buildings, but rather addressed existing improvements and future developments, to comprehend not only habitable dwellings and buildings but also any outstructures, farm implements and other such improvements "incompatible with the zoning provisions" imposed. Secondly, the statement speaks in terms of possible rather than definite relocations. More importantly, such structures and improvements contemplated by the statement do exist within the flood plain bounded by the limits of overflow from a 30-year storm.

Relocations assistance as provided in the Uniform Relocations Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) has already been applied to about 35 family units affected by the project as a result of the acquisition for the reservoir. Accordingly, any alternative which includes a reservoir feature necessarily includes such impacts.

Comment: [Inaccuracy] "While the statement contends that acquisition of greenbelt land is a matter of local action, the law, on the contrary, provides a mechanism for federal matching funds of at least 80% of such cost."

Response: Paragraph 6.03 b(1) on page VI-34 reflects the requirement for cost sharing. The cost sharing would be in accordance with Section 73 of Public Law 93-251, Water Resources Development Act of 1974.

For additional discussion, see response to Environmental Defense Fund comment on page IX-39.

Comment: [Inaccuracy] "Although the statement contends that the purchase of greenbelt lands would have to be coordinated by the Texas Water Development Board in accordance with the requirements of the existing Texas Water Plan, the law is that an acquisition program could be accomplished under Articles 1581e-1 and 8280-13, Revised Civil Statutes, without any Texas Water Plan. In any event, the Texas Water Plan is nebulous. If necessary, a greenbelt plan for the Sulphur River could be written into a Texas Water Plan."

Response: The cited statutory references appear to authorize the purchase of "greenbelt" lands by political subdivisions of the State of Texas.

Comment: [Inaccuracy] "The statement says than an acquisition plan would require acquisition of 89,200 acres. This is

false. Not even a total acquisition of a riverside corridor would necessarily involve 89,200 acres. Moreover, almost any acquisition plan would require purchase of less than the entire streambank. A few public access tracts and park sites would provide excellent recreation potential and would be far cheaper than a total acquisition. The unacquired tracts could be left in private ownership and management, subject to planning against flood prone building projects."

Response: The statement that the fee purchase alternative would require the acquisition of 89,200 acres is correct. This acquisition is based on purchase of all lands subject to overflow by the 30-year flood. Each of the structural alternatives presented contemplates protection against the 30-year flood. Concomitantly, the nonstructural alternatives contemplate the elimination of flood susceptibility of lands now affected by the 30-year flood. These criteria allow comparability of the plans in that each plan considered can be assured of compensating for 30-year flood frequency overflow either directly or indirectly.

Comment: [Inaccuracy] "The statement says that an adverse effect of non-structural floodplain management would be its failure to prevent flooding. On the contrary, this is a beneficial effect since flooding would discourage the erection of buildings in the floodplain, and thus would prevent future losses of such buildings. Flooding is also beneficial in enriching the soil, saving huge fertilizer costs. The statement claims that under non-structural floodplain management, flood control benefits would be foregone. This is contrary to the basic principles of non-structural floodplain management, which prevents flood losses, and thus has great benefits."

Response: Agricultural activity within the flood plain has evolved from row cropland production to grazing over the years, and in so doing, has resulted generally in a minimization of flood losses incurred by farmers in the Sulphur River basin. Any additional flood plain management plan would probably necessitate a relocation of existing farm operations in the flood plain to higher ground. However, as the supply of agricultural land is finite, and it can be assumed that such land is generally utilized to its maximum potential, then the displacement of such activity due to flood plain zoning or acquisition would result in a loss of associated production. In short, one cost of a flood plain management program would be the loss of flood plain-based agricultural production, which would far outweigh the flood losses prevented by program implementation. This disruption of the existing agricultural and

economic base of the area would be significant; thus, such flood plain management is considered to be an undesirable solution.

While it is recognized that periodic flooding provides nourishment to inundated soils, it is equally important that the flood losses sustained by the farmer under such conditions far outweigh the additional natural productivity of the soil during nonflood periods. Furthermore, the irregularity of flooding within the study area would seriously weaken the effectiveness of an agricultural plan designed to advantageously utilize the enrichment of the soil by flooding.

Comment: [Inacurracy] "The statement implies that under No Action approach, the silting resulting from uncompleted channel work upstream 20 years ago would persist. In truth, if the statement discussed the facts, the prior channelization caused several times the erosion and siltation which the Army Corps anticipated. Additional channelization would in reasonable probability have similar results. This damage is not truly a result of No Action, but a result of just the kinds of action which the Army Corps desires to continue."

Response: The siltation that has occurred within the basin is governed by several factors. The area in which large sediment deposits have been most pronounced and most aggravating is in the vicinity of the State Highway 37 bridge near Hagansport. The dominant factor for this occurrence is the inability of the Sulphur River to carry flood flows and its sediment load efficiently into the headwaters of Wright Patman Lake. The Sulphur River for the most part has not been channelized as envisioned in the draft EIS plan and the sinuous channel is unable to convey appreciable floodflow without the assistance of a large overbank flow area. As floodflows enter into the overbank area and water is built-up into these areas a condition known as backwater is created in the vicinity of State Highway 37. As improved portions of the upstream channels convey floodflows and sediment into this area, the backwater situation causes a reduction in the velocity of flow and consequently a deposition of its sediment load. The presently proposed plan will not alleviate these types of problems, since the total length of remaining realined channels is reduced to approximately 20 percent of that anticipated in the draft EIS plan.

Comment: [Inaccuracy] "The statement says that No Action would result in no growth. In view of the kind of growth which is often attracted when Army Corps projects so result in growth, the environment and the people of the Sulphur River watershed would be better off with no growth. However, without this project, some

growth would occur in any event a sounder more moderate growth. The long-time rise in real estate values is evidence of this."

Response: There would be some induced urbanization and recreation visitation as a result of the proposed plan, and thus, attendant growths in urban problems, public services, and public facilities. However, this effect would be moderate due to the size and location of that growth, and the accompanying increase in public revenues.

Any significant alteration of land ownership or habitation patterns due to the proposed plan would occur near lands currently devoted to urbanization. There would be no effect on such patterns within the existing flood plain. Thus, the project would have minor adverse impacts on desirable community growth patterns within the study area.

d. Others

(1) UNIVERSITY OF TEXAS, DR. CLARK HUBBS, WITNESS FOR THE PLAINTIFF (21 June 1976)

Comment: "II-67 mentions fish collections (actually only two) made in July 1953 by Dr. Strawn and me. Nowhere in the statement can I find reference to the fact that those were two random collections by two workers during which no undue effort was made to accumulate an extraordinary species list. Only parts of two days were involved - the actual man hours invested was no more than 12 hours. Despite the above, those collections are reported to include 45 fish species, three of which were not taken in any other samples. Certainly, the results of this minor effort by us is in accord with an hypothesis that sampling is incomplete; a circumstance verified by the failure to include Zygonectes olivaceus among the fishes in the basin. That list of 45 species is somewhat larger than the 29 reported by Dr. Ingold from channelized (and adjacent segments) regions. Note that a channelized stream will impact an adjacent nonchannelized segment. There is no mention of the differential despite the converse difference in collection numbers (=effort?) - i.e. 17-23 collections vs. 2. I expect that Dr. Ingold invested vastly more man hours than we did. The text implies a level of completion discordant with our two collections."

Response: With respect to the Hubbs-Strawn collections made in July 1953, there is nowhere in the Texas Memorial Museum record reference "to the fact that those were two random collections by two workers during which no undue effort was made to accumulate an extraordinary species list." Since Hubbs and Strawn

are probably the two most noted ichthyologists in the State of Texas, they have probably made hundreds of collecting trips during the 23 years that have intervened since the collection dates in question. It is therefore completely untenable to rely upon anything other than the written, original records concerning the details of the Hubbs-Strawn collections.

Concerning the hypothesis "that sampling is incomplete," a serious difficulty in semantics arises. If by the word "complete" one wishes to imply that the sampling effort has produced representatives of every species inhabiting an area, then sampling can seldom, if ever, be complete for an area as large as the Sulphur River basin of northeast Texas. Furthermore, it will always be impossible to verify "completion" without collecting every inhabitant of the area in question. When the word complete is used in the above sense, then one is obligated not to collect samples, but to collect entire populations. Most biostatisticians prefer to use the word "adequate" to describe a satisfactory sampling effort. They indeed agree that perfect sampling is an impossible ideal for most wild populations of organisms. Unfortunately, there is no statistical tool that will precisely define "adequacy" for the kind of sampling efforts that are reported in this EIS. The determination of what constitutes an "adequate" sample size can be made only by expert opinion.

According to the job completion report (Project No. F8R2, Jobs A-2-B-10), Bonn and Inman made 396 collections at 212 different locations in the lakes, sloughs, bayous, creeks, and rivers in the Sulphur River Drainage of Texas. "Four methods of collecting were employed in making this study. Each collecting site was checked with either a 1/4 inch bag or a common sense minnow seine, which resulted in a total 226 seining collections. Gill nets of 3/4- to 3-inch bar mesh were used to make 155 collections in the lakes and deeper pools of the river. Twelve hoop nets of 2-inch mesh were set in the lower river in an attempt to catch fish moving upstream during the spring rise. Rotenone collections were made to determine the total population of fishes present in three large pools on the drainage." Ingold collected fish at 35 locations in 1971 (Plate II-5). All collections were taken with seines, and all collection sites were restricted to the main channels of the North Sulphur, Middle Sulphur, South Sulphur, and Sulphur Rivers and Cuthand Creek. Collection sites were evenly distributed along the river channels from their starting places in Hunt and Fannin counties to the lower reaches of the Sulphur River near the Arkansas Border. Drs. Clark Hubbs and Kirk Strawn made two collections during July, 1953. Both collections were made in the vicinity of Wright Patman Dam and Lake, at the extreme eastern end of the

Sulphur River drainage system. Because of the extremely limited distribution of sampling sites, these collections can be considered representative of neither the Sulphur River, nor the Sulphur River drainage system. Furthermore, their remoteness in time and space from the area of major impact (i.e., the proposed project site) minimizes their usefulness in evaluating the impacts of the proposed project. Because the collections were made by two of the state's most competent ichthyologists, and because they were made within the Sulphur River drainage system, they were included in the EIS in the interests of thoroughness and objectivity.

Accordingly, the combined efforts reported in the EIS include 433 collections taken at 249 different locations throughout the Sulphur River basin. Four different collection techniques were employed and the final species list was based upon the identifications of many thousands of fish. These sampling efforts have undoubtedly produced an "adequate sample" of the fish fauna of the Sulphur River Basin. An important criterion for terminating sampling efforts of this kind is linked to a point of diminishing returns. That is, when additional effort is expended without adding new data to that already compiled, then that effort is wasted except for its usefulness in identifying a termination point. For collections (seining) within the stream channels of the North Sulphur, Middle Sulphur, South Sulphur, and Sulphur Rivers and Cuthand Creek, the first twenty collections yielded all the data that was ultimately obtained. Data from collections at Ingold's last 15 locations produced no new species, nor any new information on relative abundance. Numerous additional collections in the basin during the past four years by Ingold have not added a single new species to the list for the basin above those reported in the EIS. Although the latter studies were unrelated to the Corps EIS study, most field biologists would agree that a point of diminishing returns has indeed been reached, and that when the possiblity of additional data is weighed against the expenditure of time and money for additional sampling, additional sampling is not justified. In other words, although a sampling effort of this kind may never be "complete," the sampling effort reported in the EIS is certainly "adequate."

The blackspotted topminnow (Zygonectes olivaceus) reportedly occurs in the southeastern United States, from Oklahoma and eastern Texas to western Florida. This species was not among the thousands of fish sampled for the EIS, although the eastern portion of the Sulphur River basin is within its reported range. Its absence from the species list for the basin certainly suggests that sampling has been "incomplete." Please note once again, however, that all samples, by definition, are incomplete. A complete sample is no

longer a sample, but a total collection of the entire population(s) being studied. On the other hand, the absence of Zygonectes olivaceus from the list in no way bears upon the adequacy of the sampling effort as described above. It is important to note in this respect that the Sulphur River Basin is on the extreme western edge of the distributional range of Zygonectes olivaceus, and that a very similar and closely related sibling species, Zygonectes notatus (reported in the EIS as Fundulus notatus), replaces Zygonectes olivaceus throughout most of the Sulphur River basin. Of 78 species collected by Bonn and Inman (1955), only six were designated as "very abundant." These six species (very abundant) were the gizzard shad, red shiner, gambusia, white crappie, bluegill, and the close relative of Zygonectes olivaceus, the blackstripe topminnow (Zygonectes notatus). Thus, Zygonectes notatus appears to completely dominate its close relative throughout most of the basin. It is not surprising, therefore that Z. olivaceus is rare or absent throughout most of the basin, and it was not taken in the collections of Bonn and Inman, of Ingold, or of Hubbs and Strawn. Fortunately, Zygonectes olivaceus is not a rare or endangered species. It is quite common throughout its reported range, which lies for the most part, east of Texas.

The Hubbs-Strawn data are included in the EIS for the sake of objectivity and intellectual honesty. It in no way implies that the Hubbs-Strawn collection is or should be comparable to the Ingold collections, or vice versa. The Hubbs-Strawn collections were taken from "side pools" and from a site near the Wright Patman Dam. Factors governing the selection of these sites were not reported, but it is fair to presume that they were not selected for the purpose of obtaining representative samples of the fish fauna in the channels contributing to the Sulphur River System. Ingold on the other hand collected only from the channels of the river system. His collection sites were 35 predetermined map locations that were evenly distributed over the North Sulphur, Middle Sulphur, South Sulphur, and Sulphur Rivers and Cuthand Creek. The Hubbs-Strawn data yield no information on the fish fauna within the channels of the upper Sulphur River system, and the Ingold data likewise yield no data about the fish fauna in sidepools near Douglasville or at Wright Patman Dam. The data from the two collections are not comparable, nor were they intended to be. This is precisely why they are reported separately in the EIS, rather than being lumped. If a comparison must be made, and a conclusion drawn, it can only be that species diversity was greater at the sites sampled by Hubbs and Strawn than at the sites sampled by Ingold.

Finally, it is agreed that "a channelized stream will impact an adjacent nonchannelized segment."

Comment: "II-74&75 This table only lists relative abundance not abundance. This approach ignores the extensive documentation that absolute abundance decreases when streams are channelized. If the total fish abundance were to decrease by 75% but that of a selected species decreased only 50% there would be an artificial increase in abundance reported by this method. Actual abundance is what II-71 and 76 imply.

"All of this discussion fails again to address collection effort. How many collections were made in each streams? In the channelized vs. nonchannelized segments?

"Despite its deficiencies this table does include some valuable data that I cannot find discussed (or even mentioned) in the text. Four species were found only in that nonchannelized segment. Four others were common only in that nonchannelized segment. Strangely, the putative impacts of channelization are listed in appendix C as negligible twice for fish found only in nonchannelized segments and once for a fish found common only in the nonchannelized segment. It is extraordinarily ironic that appendix C implies that a fish not found at all is impacted less than those not found to be common. Is erradication a negligible impact? The text misleads the unwary reader."

Response: It is agreed that the data presented on pages II-74 and 75 (now pages II-48 and 49) are concerned only with relative abundance, and not abundance. The note under the title of the table, in fact, clearly emphasizes this point. It is not agreed, however, that actual abundance is implied anywhere on pages II-71 (now II-41) or II-76 (now II-50). Our experts are not familiar with "the extensive documentation that absolute abundance decreases when streams are channelized." Intuitively, however, it seems that this point is probably correct, if for no other reason than the fact that stream lengths will be substantially shortened as a result of channelization and, hence, the available aquatic habitat will be reduced. Further, no one can argue that the quality of the habitat, in terms of niche diversity, will be substantially reduced as a result of channelization. Absolute abundance, as you use the term, however, should not be confused with population density. Dr. Ingold has encountered very dense populations of fish in channelized segments of both the North and South Sulphur Rivers. Although the species involved are generally considered "trash fish," the densities were greater than on many unchannelized segments of the South Sulphur River.

Although collection effort is somewhat irrelevant in that, in a given situation, collection effort may be inversely proportional

to the number of species collected, the following is provided for your information:

1. In Dr. Ingold's collections, an attempt was made to expend equal effort at each of 35 collecting stations:

a. North Sulphur River: seven stations (two in Fannin County, five in Lamar County)

b. Middle Sulphur River: four stations (three in Hunt County, one in Delta County)

c. South Sulphur River: 10 stations (three in Hunt County, seven in Delta County)

d. Cuthand Creek: four stations (all in Red River County)

e. Sulphur River: 10 stations (five in Red River County, one in Bowie County, and four in Miller County, Arkansas)

2. Two of the South Sulphur River stations were in the proposed Cooper Lake project site. All seven of the North Sulphur River stations were in channelized segments of the stream. None of the four Middle Sulphur River stations were at channelized sites. Seven of the South River stations were at channelized sites, and three were not channelized. All four Cuthand Creek stations were at channelized sites. Nine of the Sulphur River stations were unchannelized, and one station was at a channelized site.

The four species that are referred as occurring only in unchannelized segments of the streams sampled include the bigmouth buffalo, brook silverside, dollar sunfish, and longear sunfish. Four others that were common only in the unchannelized segments include the spotted gar, orangespotted sunfish, bantam sunfish, and largemouth bass.

The impacts listed for all organisms in appendix C are estimates of how species will fare in the entire Sulphur River drainage area. The species listed above, for example, should all continue to thrive in adjacent habitats such as tributaries of the Sulphur River, bayous, backwaters, borrow pits, oxbows, ponds, etc. In other words, all the species listed above are quite versatile with respect to habitat selection, and should continue to thrive in areas adjacent to the channelization project, if not within the stream itself. Accordingly, the assessment of the relative impacts

listed in appendix C, which is now on file at the New Orleans District, is considered to be quite fair and objective.

Comment: "II-71 states that the North Sulphur River has been partly channelized. I have examined Plates I-1, VI-1, VI-2, VI-3, VI-4, VI-5, VI-6, VI-7, VI-8, VI-9, VI-11, VI-12, VI-13, VI-14, VI-15, VI-16 all of which have legends for existing channelized stream segments but I fail to find the North Sulphur so designated. What parts are channelized? That information is essential for anyone to determine the impacts of this project."

Response: The plates mentioned above do not show the limits of channelization on the North Sulphur River because their main purpose is to show the status of the authorized project. The North Sulphur River channelization was not performed as part of the Cooper Lake and channels project but rather was undertaken by local interests in 1928. Channelization on the North Sulphur River extends from the confluence of North Sulphur, South Sulphur, and Sulphur Rivers upstream for about 35 miles to State Highway 68.

Comment: "II-84 has a reference to Table II-33 which 'lists the lakes within a 100 mile radius of Cooper Lake.' I fail to find listed Atoka, Clayton, Murray, Millwood, Gilham, Lukfata, Hugo, and Wister (perhaps 100+ miles distant). I will grant that II-33 is from Texas Parks and Wildlife; they have an excuse for omitting Arkansas and Oklahoma Lakes, does the Corps? If Oklahoma inhabitants are to be included among potential users (IV-8, 9), then Oklahoma reservoirs should be included in the potential use competitors. I also note another completely nonoverlapping list of lakes on II-142. Omission of those lakes from II-84 misleads readers."

Response: Table II-33 (now table II-15) does list Arkansas and Oklahoma lakes. Murray, Wister, and Gilham are not within the hundred mile limit. Clayton and Lukfata have been authorized but not constructed. Atoka and Millwood are in the table, and recently constructed Hugo has been added.

Comment: "II-64 Benthic macroinvertebrates refers to plate II-4 but II-5 seems more appropriate. Nowhere in II-64 can I find references to abundance of benthic macroinvertebrates in existing channelized vs. unchannelized segments. Why is that information absent?"

Response: The Environmental Inventory and Survey of the Sulphur River Basin prepared by East Texas State University in 1971 served as the basic source of information regarding benthic

macroinvertebrates. This report made no reference to abundance of benthic fauna. In an effort to provide information relative to the abundance of benthic macroinvertebrates in existing channelized versus unchannelized segments of the river, pertinent findings from a 1971 Master of Science thesis study by Mr. Clifton W. Duncan, "Species Diversity of Benthic Macroinvertebrates in the South Sulphur River" (submitted to the faculty of the graduate school of East Texas State University) has been included in Section 2.05b. on page II-37.

Reference in the draft EIS was in error; the correct plate is now referenced on page II-38.

Comment: "IV-3 states that the reservoir will stratify but nowhere can I find references to the impact of stratification on biota, the impact of selected releases from different strata on downstream organisms. You may have assumed this last not to be critical as channelization will (or has) undoubtedly reduced the indigenous biota far more than would mismanagement of the outlet works. The design and operations of the outlet works would help to predict biologic impacts."

Response: We concur that stratification will certainly influence the kinds and seasonal distribution of reservoir organisms. The deterioration of water quality that can be expected in the hypolimnion, as indicated on page IV-18, should adversely effect certain species of benthic fauna. As in most stratified lakes, however, the ecosystem will stabilize and support certain types of organisms at each stratum.

Since a considerable amount of channel has already been completed immediately below the proposed dam site, we would expect, as you noted, that the impact of selected releases from different strata would not have a significant impact on downstream organisms within the channelized segment. Such impacts would probably be masked by the more severe impacts of channelization.

Should the channelized segment become sinuous again, multi-level releases may have a significant effect on downstream organisms. Accordingly, we have discussed the design and operation of the outlet works in Section 1.03 on page I-2.

Comment: "IV-6 suggests that increased water will 'enhance available habitat' for the American alligator. This statement typifies the simplistic approach of the draft statement. What type of waters are inhabited by alligators - reservoirs or swamps?

Which type will increase in abundance? Similarly, what waters are stream fishes adapted to inhabit?"

Response: Within its normal range, the American alligator is compatible with a variety of aquatic habitats. The US Department of the Interior in its 17 August 1976 letter of comment relative to the draft Cooper Lake and Channels EIS attests to the existence of a remnant native population of alligators in the Sulphur River Basin. Mr. Earnest Jemison, Manager of the Tishomingo National Wildlife Refuge at Tishomingo, Oklahoma, indicated that he knew of a few alligators inhabiting several small privately owned farm ponds in the area (telephone conversation with Mr. Jemison on 27 August 1976). Further, he indicated that Cooper Lake and especially the tributaries leading into it would serve as acceptable habitat in which to stock alligators. He advised, however, that control of poaching may be the most important factor in assuring the success of such an endeavor.

Generally we agree with your inference that some stream fishes will not adapt to reservoir conditions. In fact, we address this fact on page IV-4 of the EIS.

Comment: "IV-12 states (without documentation) that oxbow cutoffs 'are known for their high degree of sport fishery potential.' Have you considered references such as Beecher, Hixon, and Hopkins' 1976 report of reduced diversity in oxbows contrasted with the present river? A gain in one kind of fish may entail a loss in another."

Response: Concur that diversity will be reduced. However, "high degree of sport fishery potential" and "diversity" are not necessarily related. High diversity implies a variety of niches, each occupied by a different species. The result is a complex food web with energy being "channeled" in many different directions, resulting in a large number of species, most of which are not harvestable by man. Whenever a terrestrial or aquatic community is being managed to produce a crop harvestable by man, it is desirable to minimize the number of different "channels" into which energy may be flowing, in order to maximize energy flow into the "channel" that results in a harvestable crop. The ability to produce a harvestable crop of popular game fish is the primary step in assuring a high degree of sport fishery potential. A popular fish management strategy for lakes and ponds involves eradicating all species, and starting over by stocking selected species that most efficiently "channel" available energy into harvestable species. The result, of course, is reduced diversity, but greater fishing potential.

Comment: "Appendix C. I find this appendix is totally inadequate and misleading. It is so bad that I deferred reading any other section when I read it. I have not found any reference to the Appendix in those sections I have read. For example V-1 states that 'In excess of 50 percent of the fish species presently occurring in the natural river may be reduced or eliminated from that reach of the river that will be inundated by the lake,' and channelization will have similar results on the fauna. Appendix C has 45-48% of the fishes receiving 'negligible' impact. By interference then all impacts listed in Appendix C are negative. This is clearly in error.

"The most critical and pervasive deficiency in Appendix C is that impacts are not listed as positive or negative. No reader is able to determine what is the projected change - plus or minus. Is an extensive impact an extensive increase or decrease? This applies to all parts of Appendix C."

Response: Reference to appendix C was made in the beginning of the discussion of Zoological Elements (page II-64 in the draft EIS; now page II-37).

The purpose of the impact assessments, included in the various appendixes, is to provide an understanding of the overall impact of the two primary features of the recommended plan. To say whether the effect will be positive or negative would be a value judgement which was not made. The purpose of the appendixes, as perceived, is not to predict faunal and floral populations in Cooper Lake or the channelized stream in year one or five, but rather to indicate the overall effect of project features on species which currently exist in the basin. If a species in question is still thriving in adjacent woods, fields, tributaries, etc. and a scientist or naturalist can still locate and study or observe the organism in the basin, we feel that we have not drastically affected that species.

Comment: "There is a listing 'general habitat' with different key categories for Invertebrates, Fishes, Herptiles, Birds and for Mammals. Some categories are nonsense. Where in the project area will one find Marine, Lower by 15-30 ppt, offshore more than 10 fathoms, etc.? Never are these short listings defined. For example how does a stream differ from a large creek, etc., etc. Lakes and reservoirs are considered to be the same things. They are not."

Response: Appendix C was computerized in order to facilitate its preparation. The computer format necessitated

certain space limitations; therefore, selection of only a limited number of habitats to categorize the entire US Army Corps of Engineers, New Orleans District, from the Sulphur River to the Gulf of Mexico, was possible. For this reason, lakes and impoundments are considered the same category; lakes are more similar to impoundments than to any other category listed under general habitats. The general habitats, or "short listing," are now defined in appendix C, which is now on file in the New Orleans District.

Comment: "The classification of 'important fishes' is unrealistic. Centrarchus macropterus and Lepomis megalotis are listed as sport fishes but Lepomis auritus is not. Minytrema melanops and Dorosoma petenense are listed as commercial fishes but Carpiodes carpio is not. I wonder whether you have any estimate on the gross value of Notropis lutrensis, Pimephales promelas and Semotilus atromaculatus sales. I would guess the total would be near $1,000,000 annually in the United States."

Response: We concur that Lepomis auritus should have been listed as a sport fish in the draft EIS; this error has been corrected in the appendix which is now on file at the New Orleans District. Similarly, Carpiodes carpio is now listed as a commercially important species.

Notropis lutrensis and Pimephales promelas are commercially important, but the production is on private fish farms. Minnows cannot be taken from public waters for commercial purposes; their commercial value would be only that small amount used by fishermen who "seine their own bait." Semotilus atromaculatus is not normally produced commercially and has little importance as a bait fish. Accordingly, we contend that the commercial value of these fishes is not from natural waters as you imply.

Comment: "You list Etheostoma artesiae as uncommon but do not list it as having a habitat. You list Pimephales notatus as living in two habitats but 'may not occur in the state.' The 'negligible' impact of the project on both species may be realistic in as much as they are both undoubtedly absent. The U. S. listing for several other species implies absence in Texas; the range listing for Dorosoma petenense is clearly suspect on nomenclatural grounds alone. Similarly, the negligible impacts listed for Alosa chrysochloris and Anguilla rostrata seem reasonable as it is likely that the dam impounding Wright Patman (=Texarkana) Lake had exterminated both already."

Response: Etheostoma artesiae is now listed in the appendix which is on file at the New Orleans District, as inhabiting

small rivers, large creeks, and streams. We agree that we may have been in error in including Pimephales notatus as a species which is established in the Basin, and we have removed it from Appendix C.

Although we are uncertain what you mean by "Dorosoma petenense is clearly suspect on nomenclatural grounds alone," the statement suggests that you place this species in synonomy with another species. However, we can find nothing in the recent literature that verifies such a possibility. All the fish keys, including Hubbs' "Key to the Freshwater Fishes of Texas" (1964) and Hubbs' "A Checklist of Texas Freshwater Fishes" (1972) list it as an occupant of Texas freshwaters. Dorosoma petenense was collected by both Ed Bonn (1955) and Dr. Donald Ingold in his collections for the inventory performed by East Texas State University.

Comment: "When I examined the listed impacts of the project on fishes I was shocked at the discrepancies from those I would make. The erroneous nature of those listings has been alluded to above based on the discordance with the actual samples reported in Table II-29. To determine whether my estimate of judgment quality was realistic I set up a test with two experienced fishery biologists. These tests were run independently so that concordance of results were not due to communication among these scientists. I pointed out that two impacts - reservoir construction and channelization of the river downstream were involved and that 4 categories of change were available. Each protested about the problem of increased or decreased populations but agreed to answer in the form presented in the impact statement. Evaluations were made on 84 species (with the 2 impacts on each there are 168 estimates) and four impacts are available. Each estimate has one possibility in four of being concordant by chance, or random choices would be 42 identical responses. The actual data were 20 and 21 or less than half of the chance potential. The two individually agreed 105 times or an agreement 5 times as great as either with the impact statement. Concordance tests were run on other biologists. All six agreed with the impact statement evaluations less frequently than by chance. A 60% independent concordance between predictions by experts is not bad (actually it is 35% above chance) and shows that this approach is reasonable. A proper prediction is possible and would be helpful to those reviewing the draft statement. The discordances with the printed estimates are substantial and statistically significant. Both fisheries biologists independently had the same level of discordance. The parsimonious conclusion is that the evaluations in the impact statement are not discordant by change or by lack of information. Those evaluations will misleadingly inform most readers that the impacts (+ or -) are understood."

Response: The impacts of project features were assessed on fish populations throughout the Sulphur River Basin. It appears that your evaluation of the impacts of the project on fishes occurs in the specific reservoir area and areas to be channelized. With this in mind, we are not alarmed by the large degree of discordance.

(2) CITY OF IRVING, TEXAS, MAYOR (24 June 1976)

Comment: "Our engineering staff has reviewed the report and found it to be complete and concise in all respects. It is our opinion that there is nothing contained therein that should cause any modifications or alterations to THE COOPER PROJECT.

"It is the recommendation of the City of Irving that THE COOPER LAKE AND CHANNEL PROJECT proceed with all deliberate haste to its ultimate completion in order that the benefits derived therefrom will not be delayed."

Response: Noted.

(3) MR. ALBERT ROACH (23 July 1976)

Comment: "We believe that the Cooper dam and the planned channel works are vital to the industrial development and growth of the northeast Texas area. Water resources properly developed are very beneficial to our progress and growth; uncontrolled, they are very destructive and harmful to growth and development. The undeveloped and uncontrolled waters of the Sulphur River Watershed are destroying or rendering useless thousands of acres of good land in its present undeveloped state. We cannot afford further delay in implementing this project if we are to continue the economic growth and development of our state and nation."

Response: Noted.

(4) COUNTY JUDGE AND COMMISSIONER'S COURT OF THE COUNTY OF FRANKLIN (26 July 1976)

Comment: "...the agriculture industry is a major part of the economy of Franklin County and will be benefited by the control of flooding by the Cooper Reservoir and Channels project; and

"The economy of several Northeast Texas counties will be benefited by additional adequate water supply, recreation and flood control....

"...we endorse and support the environment impact statement prepared by the U. S. Corps of Engineers...."

Response: Noted.

(5) NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS (NCTCOG) (29 July 1976)

Comment: "The NCTCOG Review Process has disclosed no conflict with the review criteria of areawide comprehensive planning as outlined in OMB (Office of Management and Budget) Circular A-95 (revised). Based on our review of the Draft EIS, it is recommended that the Cooper Lake and Channels project be constructed on the basis that NCTCOG's Regional Water Supply Plan identifies this project as an important source of additional water to serve the expanding water supply needs within the North Central Texas region."

Response: Noted.

(a) CITY OF COMMERCE, TEXAS, MAYOR

Comment: "Yes, failure to complete Cooper Reservoir will have a significant impact on Commerce's projected water supply.

"I am definitely of the opinion that the apparent benefits of the proposed project are greater than the environmental consequences."

Response: Noted.

(b) NORTH TEXAS MUNICIPAL WATER DISTRICT (MWD)

Comment: "The Cooper lake project is vital to the future water supply needs of the 11 member cities of the North Texas MWD and its additional customer cities. The approximate 1/3 share of the total project costs estimated to be borne by the North Texas MWD now exceeds the total 1968 estimated cost of the entire project. Future delays in construction will only result in higher project costs which will ultimately have to be passed on to the North Texas MWD's customers. The District's need for an additional water supply will occur prior to 1983. The earliest possible completion date of the project is 1982, so initiation of construction activity is urgently needed."

Response: Noted.

(c) CITY OF IRVING, TEXAS

Comment: "The City of Irving strongly supports the completion of the Cooper Reservoir project. The City feels that the project

will definitely be of benefit to the citizens of Irving in ensuring an adequate future water supply."

Response: Noted.

(6) SOUTHERN METHODIST UNIVERSITY, DR. ALAN SKINNER, RESEARCH ARCHEOLOGIST (2 August 1976)

Comment: "On a general level, the section [2.07 Archeological and Historical Elements] provides a concise overview of the prehistoric and historic settlements characteristic of the East Texas area. A cultural chronology is established, and the diagnostic elements used to define the periods within the chronological framework are well described."

Response: Noted.

Comment: "A total of 283 sites have been located in the Sulphur River Basin from surveys conducted in the Cooper Lake project area, the Wright Patman Lake area, and the channeling operation area near Talco, Texas. Appendix D inventories the sites recorded for the Cooper Lake area, and the area east of Talco, but not for the Wright Patman Lake area (140 sites). Is there a specific reason for omitting this information?"

Response: It is known that a total of 283 sites have been located in the Sulphur River Basin from surveys conducted in the Cooper Lake project area, the area east of Talco, and the Wright Patman Lake area. The sites located in the Wright Patman Lake area have been omitted from Appendix D since this project is funded separately and will be the subject of separate studies and EIS.

Comment: "The sites from the Talco area are supposed to be representative of the Paleo Indian through the Neo-American stages. This however, is not indicated in the site inventory (Appendix D). Dated sites in the inventory all fall into the Archaic and the Neo-American time ranges."

Response: Paragraph 2.07a(2)(a) on page II-75 of the text has been amended to indicate the correct stage.

Comment: "The 1974 investigation of the Arnold Site (X41HP 34) by Southern Methodist University yielded a total of ten human burials, rather than nine. Osteological analysis of the skeletal material revealed that two individuals were represented at a given burial location, thereby increasing the size of the population.

Nine of the burials (rather than eight) appeared to form a circular pattern in the southeastern portion of the site."

Response: The necessary changes have been made in paragraph 2.07a(2)(b)4 on page II-78.

Comment: "Section 5.05 (V-2) evaluates the probable impact of the reservoir construction on the cultural resources present in the study area. Mention is made of 90 sites within the floodpool limits, and two sites beneath the dam area. No mention is made of the 18 known sites directly adjacent the the floodpool. These too will certainly be affected, although indirectly, rather than directly by inundation. Provisions should be made for these sites as well."

Response: Upon completion of the ongoing testing, a determination will be made as to whether any further scientific data can be obtained from any of these sites.

Comment: "It is felt that the summary of the investigations conducted by Southern Methodist University is incompletely represented. Appended here is a revision of that summary, giving a more comprehensive overview of research objectives and accomplishments to date. We hope this will be of use to you in revising the draft report."

Response: The revised summary has been incorporated in paragraph 2.07a(2)(b) on page II-76.

(7) DR. DOUGLAS S. GALE (9 August 1976)

Comment: "Like most of my neighbors, I support the construction of Cooper Lake. A dependable source of water is badly needed in this part of Texas. I do not, however, support the proposed channelization below the reservoir. Unfortunately, most of the residents of northeast Texas, in their enthusiasm for the reservoir, have failed to distinguish between the reservoir and the proposed plan which includes channelization."

Response: Noted.

Comment: "The net effect of the channelization will be to protect a few thousand acres of relatively little used river bottom land from being flooded during a 'thirty year flood' --at a cost of 4.5 million dollars. In Commerce Texas alone I could point out many homes that will be flooded during the 'thirty year flood,' yet the proposed plan would spend 4.5 million dollars to protect this

largely uninhabited river bottom land. Perhaps the old phrase should be rewritten: 'The maximum good for the minimum number.'"

Response: An economic analysis of the flood protection provided by the levees and channels feature of the proposed plan, strictly on its own merits, is ascertainable from another planning document, "Alternative Plan Studies," which is on file at the New Orleans District office. A comparison between the flood control analyses therein for the "reservoir only" plan and the "reservoir and levees" plan (selected plan) reveals that inclusion of the levees in the selected plan as a flood control feature is economically justified.

Comment: "It should also be noted that to protect this small area it will be necessary to destroy 9,620 acres of the area that is supposedly to be protected. This area that will be destroyed harbors a large variety of wildlife. The wildlife in the remaining 'protected' areas will be drastically altered since the channelized river will not provide the habitat of a free flowing river."

Response: Channelization will be reduced by 80 percent and much of the natural river will be preserved in the selected plan.

(8) ARK-TEX *COUNCIL OF GOVERNMENTS* (13 August 1976)

Comment: "...the above project, as proposed by current US Army Corps of Engineers Plans, will substantially benefit the entire region, either directly or indirectly, in the areas of economic development, water supply, flood control and recreational development, and should not be altered or changed at this point in time.

"...the above mentioned project is desirable and urgently needed for the public safety and welfare, and should be initiated at the first opportunity.

"...completion of the above project will economically, socially and physically benefit the Ark-Tex Council of Governments Region by increasing the supply of surface water to the western end of the region through Cooper Lake itself, by increasing the supply of surface water to the eastern end of the region through the conversion of 120,000 acre-feet of existing storage space in Wright Patman Lake from flood control to water supply, by controlling flood conditions in the Sulphur River Basin, and by increasing the supply of regional recreational facilities available to the public."

Response: Noted.

9.03 COMMENTS REQUESTED BUT NO RESPONSES WERE RECEIVED

a. Federal agencies

Lloyd M. Bentsen, US Senator
John G. Tower, US Senator
Ray Roberts, US Congressman
US Department of Agriculture, Arkansas State Conservationist, Soil Conservation Service
US Department of Agriculture, Texas State Executive Director, Agricultural Stabilization and Conservation Service
Federal Energy Administration, Director, Environmental Impact Division, Office of Environmental Programs
US Department of Housing and Urban Development, Regional Administrator, Region VI
US Department of Housing and Urban Development Area Office, Director, New Orleans, Louisiana
US Department of Housing and Urban Development - Region IV, Assistant Regional Administrator for CPD, Attn: Environmental and Standards Officer
US Department of Justice, Assistant US Attorney
US Department of Justice, US District Court, Eastern District of Texas

b. Environmental groups

Texas Conservation Groups
National Audubon Society, Library
National Audubon Society, Southwestern Regional Office, Regional Representative
National Audubon Society, Field Research Director
National Audubon Society, Director of Audubon Sanctuaries
National Sierra Club, San Francisco
ARK-LA-TEX Group Sierra Club, Shreveport
National Sierra Club, New Orleans
National Wildlife Federation, Washington, DC
Sportsmen's Clubs of Texas, Austin, Texas
Wildlife Management Institute, Washington, DC
Wildlife Management Institute, South-Central Field Representative
The Conservation Foundation
Natural Resources Defense Council
Environmental Information Center, Inc.
League of Women Voters of Texas
League of Women Voters of Arkansas

The Coalition on American Rivers
Arkansas Ecology Center
Arkansas Wildlife Federation, Inc.
Arkansas Audubon Society
Sierra Club, Lone Star Chapter
Texas Conservation Council, Inc.
Ozark Sierra Club
Sierra Club, Conservation Committee
The Fund for Animals, Inc., Field Agent
Dallas County Audubon Society

c. <u>Others</u>

Gulf States Marine Fisheries Commission
Arkansas Planning Commission
Texoma Regional Planning Commission
East Texas Council of Governments
Red River Valley Association, Director
Red River Valley Association, Vice President
Sulphur River Municipal Water District, President
North Texas Municipal Water District (Attorney for)
Texas Committee on Natural Resources (Attorney for)
Levee District No. 1, Red River County (Attorney for)
Chamber of Commerce, Texarkana, Executive Vice President
Director of Public Works, Irving, Texas
Chamber of Commerce, Delta County, President
East Texas State University, Library
Southern Methodist University, Library
Northeast Texas Economic Development District
Lake Texarkana Water Supply Corporation
Miller County Drainage and Improvement District
City of Irving, Texas, President, Chamber of Commerce
City of Cooper, Texas, Mayor
City of Cooper, Texas, President, Chamber of Commerce
City of Commerce, Texas, President, Chamber of Commerce
City of Sulphur Springs, Texas, Mayor
City of Sulphur Springs, Texas, President, Chamber of Commerce
City of Texarkana, Ark-Tex, Mayor
City of Texarkana, Ark-Tex, President, Chamber of Commerce
Chamber of Commerce, East Texas
Board of County Commissioners, Bowie County, Chairman
Board of County Commissioners, Camp County, Chairman
Board of County Commissioners, Cass County, Chairman
Board of County Commissioners, Delta County, Chairman
Board of County Commissioners, Fannin County, Chairman
Board of County Commissioners, Hopkins County, Chairman
Board of County Commissioners, Hunt County, Chairman

Board of County Commissioners, Lamar County, Chairman
Board of County Commissioners, Morris County, Chairman
Board of County Commissioners, Rains County, Chairman
Board of County Commissioners, Red River County, Chairman
Board of County Commissioners, Titus County, Chairman
Board of County Commissioners, Wood County, Chairman
Miller County, County Judge
Texas Archeological Society, Dallas, Texas

LITERATURE CITED

A. H. Belo Corporation. 1973. Texas almanac and state industrial guide 1972-73.

Anonymous. 1972. Rare and endangered plants native to Texas. 2nd ed. Rare Plant Study Center, Univ. of Texas, Austin. n.p.

Ark-Tex Council of Governments. 1971. Interim land use plans. Prepared by Planning Associates, Inc., Tulsa, Okla.; financed by Dept. of Housing and Urban Development, under the Urban Planning Assistance program authorized by Section 701, Housing Act of 1954, USDA. 32 p.

Ark-Tex Council of Governments. 1972. Open Space Plan - An Element of the Regional Comprehensive Plan. Prepared by the Ark-Tex Council of Governments. Texarkana, Texas; financed through a State Planning Assistance Grant, State of Texas, and through a Federal Grant from Dept. of Housing and Urban Development, under the Urban Planning Assistance Program authorized by Section 701, Housing Act of 1954 (as amended). 104 p.

Bellrose, Frank. 1973. Ducks, geese, and swans of North America. Stackpole Books, Harrisburg, Pennsylvania. 543 p.

Bonn, E. W. and Inman, C. R. 1955. Basin survey and inventory of species present and their distribution in the Sulphur River in Texas. Project No. F8R2, Jobs A-2 and B-10. Texas Parks and Wildlife Department, Austin.

Braun, E. Lucy. 1950. Deciduous forests of North America. The Blakiston Co., Philadelphia. 596 p.

Broadfoot, W. M. 1967. Shallow-water impoundment increases soil moisture and growth of hardwoods. Soil Science Proceedings 31: 562-564.

Broadfoot, W. M. and H. L. Williston. 1973. Flooding effects on southern forests. Journal of Forestry 71: 584-587.

Broom, M. E., et al. 1965. Ground-water resources of Camp, Franklin, Morris, and Titus Counties, Texas. Texas Water Commission. Austin, Texas. 153 pp., 12 tbls., 13 figs., 3 pls.

Brown, B. C. 1950. An annotated checklist of the reptiles and amphibians of Texas. Baylor University Press. Waco, Texas.

Conant, R. 1958. A field guide to reptiles and amphibians. Houghton Mifflin Co., Boston. 366 p.

Davis, E. Mott. 1970. Archeological and historical assessment of the Red River in Texas. In Archeological and Historical Resources of the Red River Basin, ed. Hester A. Davis. Arkansas Archeological Research Series, No. 1.

Davis, W. B. 1966. The mammals of Texas. Texas Parks and Wildlife Dept., Austin. Bull. 41. 267 p.

Duncan, C. W. 1971. Species diversity of benthic macroinvertebrates in the South Sulphur River. Unpublished Master of Science Thesis, East Texas State University, Commerce, Texas.

East Texas State University. 1971. An environmental inventory and survey of the Sulphur River Basin. Dept. of Army, New Orleans District, Corps of Engineers (Contract No. DACW29-71-C-0230). 299 p.

East Texas State University. 1972. Attitudes of community residents toward Cooper Reservoir and Sulphur River channeling program. Dept. of Army, New Orleans Dist. Corps of Eng. (Contract No. DACW 29-71-C-0230). 24 p.

Fisher, W. L. 1965. Rock and mineral resources of east Texas. Texas Bureau of Econ. Geol. University of Texas. Rpt. Invest. 54. viii + 439 pp., 11 figs., 6 pls., 49 tbls.

Forrest and Cotton, Inc. (Consulting Engineers, Dallas, Texas). 1967. Cooper reservoir and channels, Sulphur River, Texas: Forrest and Cotton, Inc., for US Army, Corps of Engineers, New Orleans District, xivi + 366 p., 13 figs., 32 pls., 99 tbls.

Fulton, Robert L. and Clarence H. Webb. 1953. The Bellvue mound: a pre-Caddoan site in Bossier Parish, Louisiana. Bulletin of the Texas Archeological Society.

Gould, F. W. 1975. Texas plants - a checklist and ecological summary. Texas Agr. Expt. Sta. MP-585 (Revised). 121 p.

Greding, E. J. 1962. A survey of the amphibians and reptiles of the Commerce, Texas, area. Unpubl. master's thesis. East Texas State University, Commerce.

Griffith, William Joyce. 1954. The Hasinai Indians of East Texas as seen by Europeans, 1687-1777. Tulane University. Middle American Research Institute. Philological and Documentary Studies. 2: 3.

Harris, R. K. 1953. The Sam Kaufman site, Red River County, Texas. Texas Archeological Society Bull. 24: 43-68.

Hubbs, C. and K. Strawn. 1953. A list of fishes collected from side pools of Sulphur River and from Sulphur River to Texarkana Dam (Q53-97 and Q53-94). University of Texas Museum, Austin.

Hyatt, Robert D., B. H. Butler, and H. T. Mesca III. 1974. Archaeological research at Cooper Lake, 1970-72. Southern Methodist University. Contributions in Anthropology, No. 12.

Hyatt, R. D. and S. A. Skinner. 1971. Archeological resources of the Cooper Reservoir, Texas. Report submitted to the National Park Service by the Department of Anthropology Southern Methodist University.

Jelks, Edward B. 1955. Excavations at Texarkana Reservoir, Sulphur River, Texas. Smithsonian Institution Bureau of American Ethnology. Bulletin 179.

Jensen, Harold T., Jr. 1968. Coral Snake mound, X16SA48. Bulletin of the Texas Archeological Society: 9-44.

Johnson, Leroy, Jr. 1962. The Yarbrough and Miller sites of northeastern Texas, with a preliminary definition of the LaHarpe aspect. Bulletin of the Texas Archeological Society, vol. 32. Austin.

Kolb, C. R., _et al_. 1958. Geological reconnaissance, Cooper dam site, South Sulphur River, Texas. Dept. of Army, Corps of Engineers, Waterways Experiment Station, Vicksburg, Miss. vii + 20 pp, 4 figs., 2 pls.

Krieger, A. D. 1946. Culture complexes and chronology in northern Texas. Univ. of Texas Publ. No. 4640.

Lowery, G. H., Jr. 1943. Checklist of the mammals of Louisiana and adjacent waters. Louisiana State University Press, Baton Rouge. Occas. Paper 13 of the Museum of Zoology. p. 12-57.

Lowery, George H., Jr. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State University Press, Baton Rouge. 565 p.

Miller, R. R. 1972. Threatened freshwater fishes of the United States. Trans. Amer. Fish. Soc. 101: 239-52.

Moorman, E. H. and E. B. Jelks. 1952. Appraisal of the archeological resources of the Cooper Reservoir, Delta and Hopkins Counties, Texas. River Basin Surveys. Smithsonian Institution, Texas Area.

Murray, Grover E. 1961. Geology of the Atlantic and Gulf Coastal Province of North America. Harper and Brothers, Publishers. xvii + 692 pp.

Newell, H. Perry and Alex D. Krieger. 1949. The George C. Davis site, Cherokee County, Texas. Society for American Archaeology, Memoir 5.

Smithsonian Institute. 1975. Report on endangered and threatened plant species of the United States. US Government Printing Office, Washington, DC. Serial No. 94-A.

Suhm, Dee Ann, A. D. Krieger, and E. B. Jelks. 1954. An introductory handbook of Texas archeology. Texas Archeological Society, Vol. 25.

Swanton, John K. 1942. Source material on the history and ethnology of the Caddo Indians. Smithsonian Institution, Bureau of American Ethnology. Bulletin 132.

Texas Parks and Wildlife News. 14 November 1973. Endangered species list to get hearing. Texas Parks and Wildl. Dept., Austin. mimeo. n.p.

Texas Railroad Commission, Oil and Gas Division, Austin, Texas. 1973. Letter to E. Burton Kemp III: Railroad Commission of Texas, 29 November 1973, 1 p. with 3 p. inclosures.

Texas Water Development Board. 1968. The Texas water plans (second printing). Texas Water Development Board. Austin, Texas.

Texas Water Quality Board. 1973. Texas water quality standards. Austin, Texas. 78 p.

US Department of Agriculture, Forest Service. 1967. East Texas piney woods.

US Department of Agriculture, Forest Service. 1971. Timber resource statistics for midsouth counties.

US Department of Commerce, Bureau of the Census. 1950, 1960, 1970. Number of inhabitants, Texas. Census of population.

US Department of Commerce, Bureau of Economic Analysis. 1974. 1972 OBERS projections, series E, population, regional economic activity in the US Government Printing Office, Washington, DC.

US Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census. 1975. 1972 Census of manufactures.

US Department of the Interior, Bureau of Mines. The mineral industry of Texas (preprint). 1970 Bureau of Mines minerals yearbook. Vol. 3.

US Department of the Interior, Bureau of Mines. The mineral industry of Texas (preprint). 1972 Bureau of Mines minerals yearbook. Vol. 2.

US Department of the Interior, Fish and Wildlife Service. 1974. United States list of endangered fauna. 22 p.

Waring, A. J., Jr., and Preston Holder. 1945. A prehistoric ceremonial complex in the southeastern United States. American Anthropologist: 47(1): 1-34.

Webb, Clarence H. 1948. Caddoan prehistory: the Bossier focus. Bulletin of the Texas Archeological and Paleontological Society. 19: 100-47.

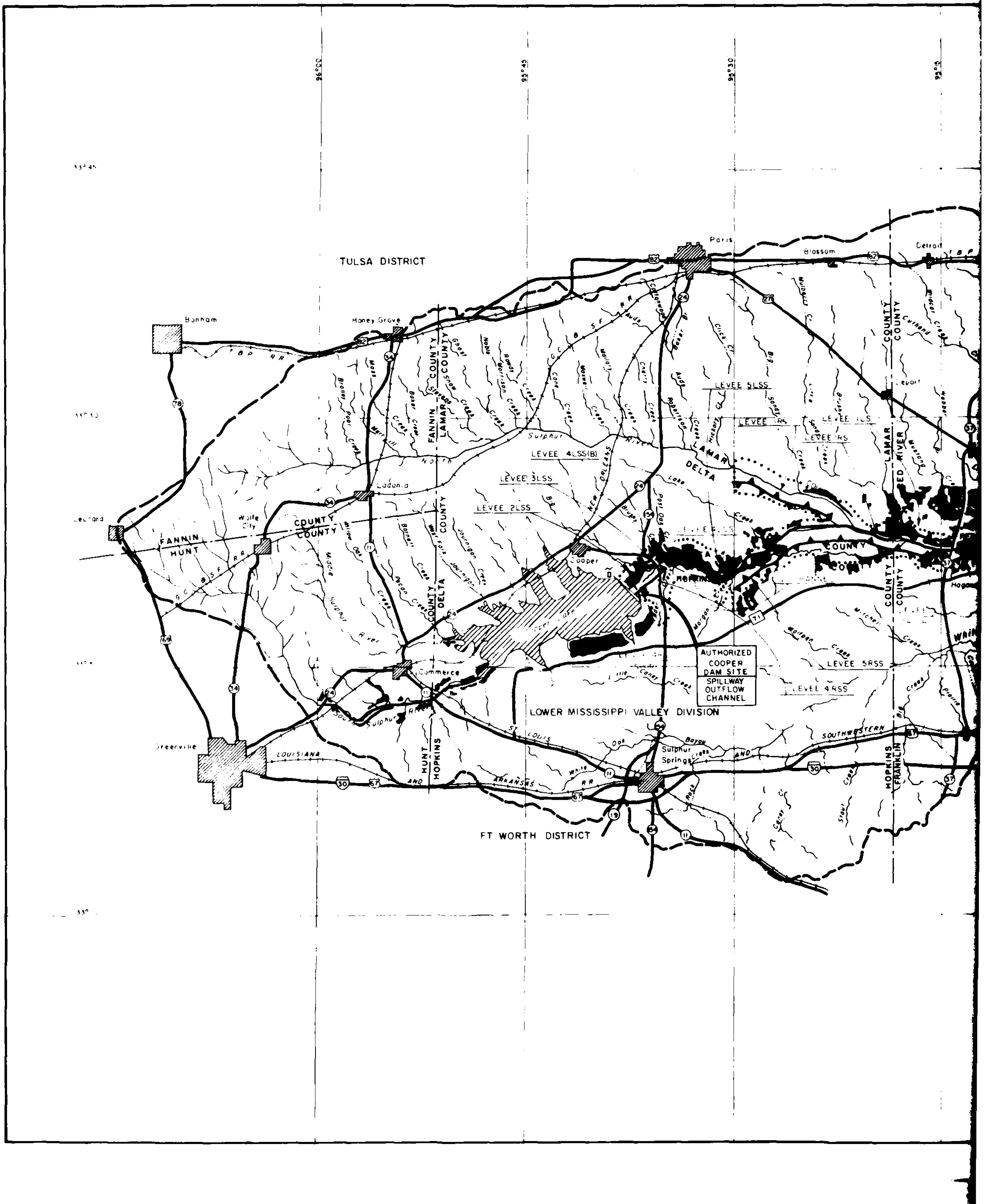
Webb, C. H. 1958. A review of northeast Texas archeology. Texas Archeological Society Bull. 29: 35-61.

Webb, Clarence H. 1963. The Smithport Landing site: an Alto focus component in DeSoto Parish, Louisiana. Bulletin of the Texas Archeological Society. 34: 143-87.

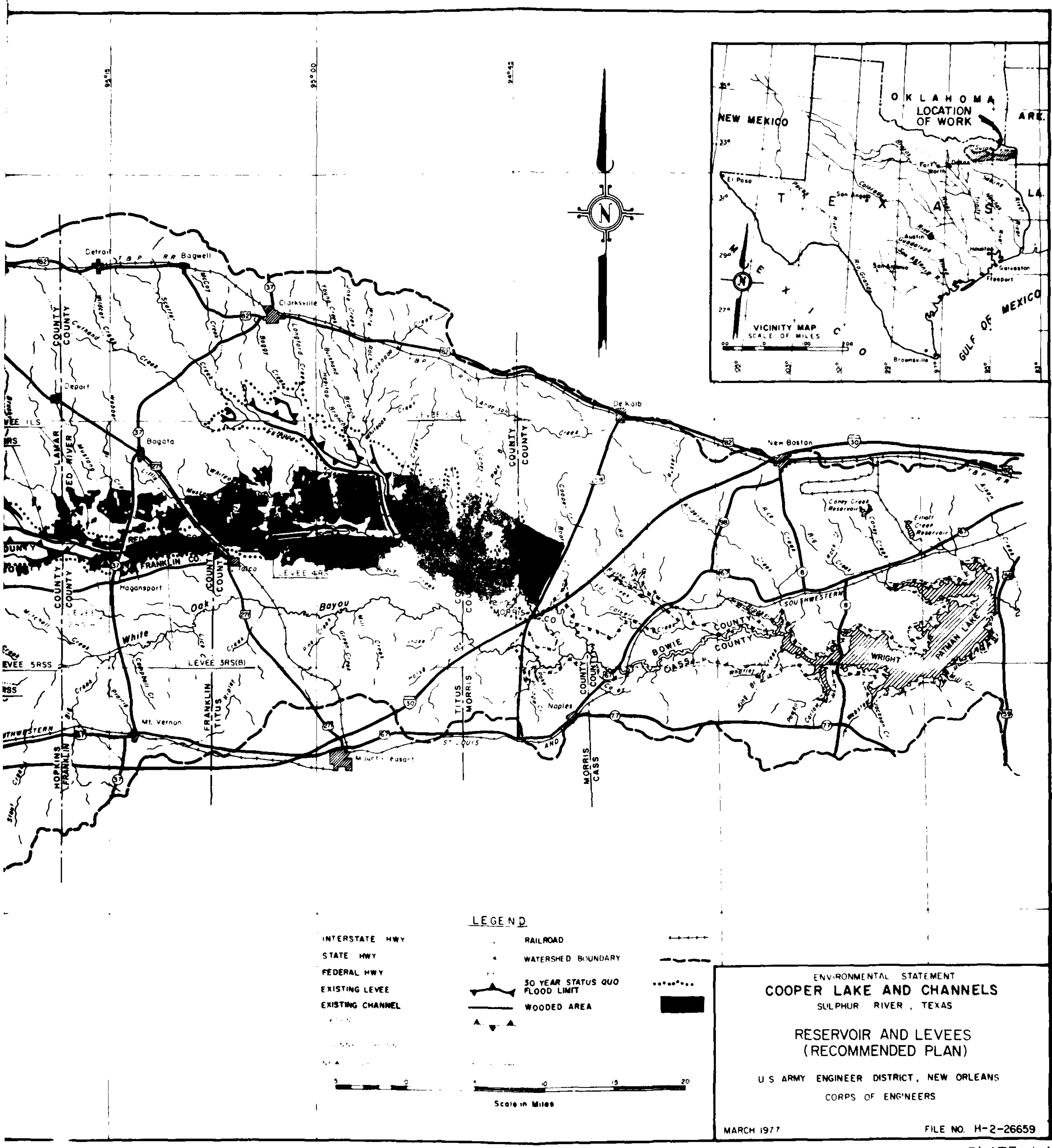
Webb, Clarence H. and Monroe Dodd, Jr. 1939. Further excavations of the Gahagan mound: connections with a Florida culture. Bulletin of the Texas Archeological and Paleontological Society. 11: 92-127.

Woodall, J. Ned. 1969. Cultural ecology of the Caddo. Unpubl. Ph. D. thesis. Southern Methodist University.

Wright, A. L. 1974. The status of land use planning in Texas and the Nation. Paper presented to Texas Soil Survey Work-Planning Conference, Texas A&M University, College Station. 17 p.



96°00'
95°45'
95°30'
TULSA DISTRICT
Paris
Blossom
Detroit
Bonham
Honey Grove
Ladonia
Wolfe City
Cooper
Commerce
Greenville
Sulphur Springs
FANNIN COUNTY
HUNT COUNTY
LAMAR COUNTY
DELTA COUNTY
HOPKINS COUNTY
FRANKLIN COUNTY
RED RIVER COUNTY
LEVEE 5LSS
LEVEE 4LSS(B)
LEVEE 3LSS
LEVEE 2LSS
LEVEE 5RSS
LEVEE 4RSS
AUTHORIZED COOPER DAM SITE
SPILLWAY OUTFLOW CHANNEL
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT



ENVIRONMENTAL STATEMENT

COOPER LAKE AND CHANNELS

SULPHUR RIVER, TEXAS

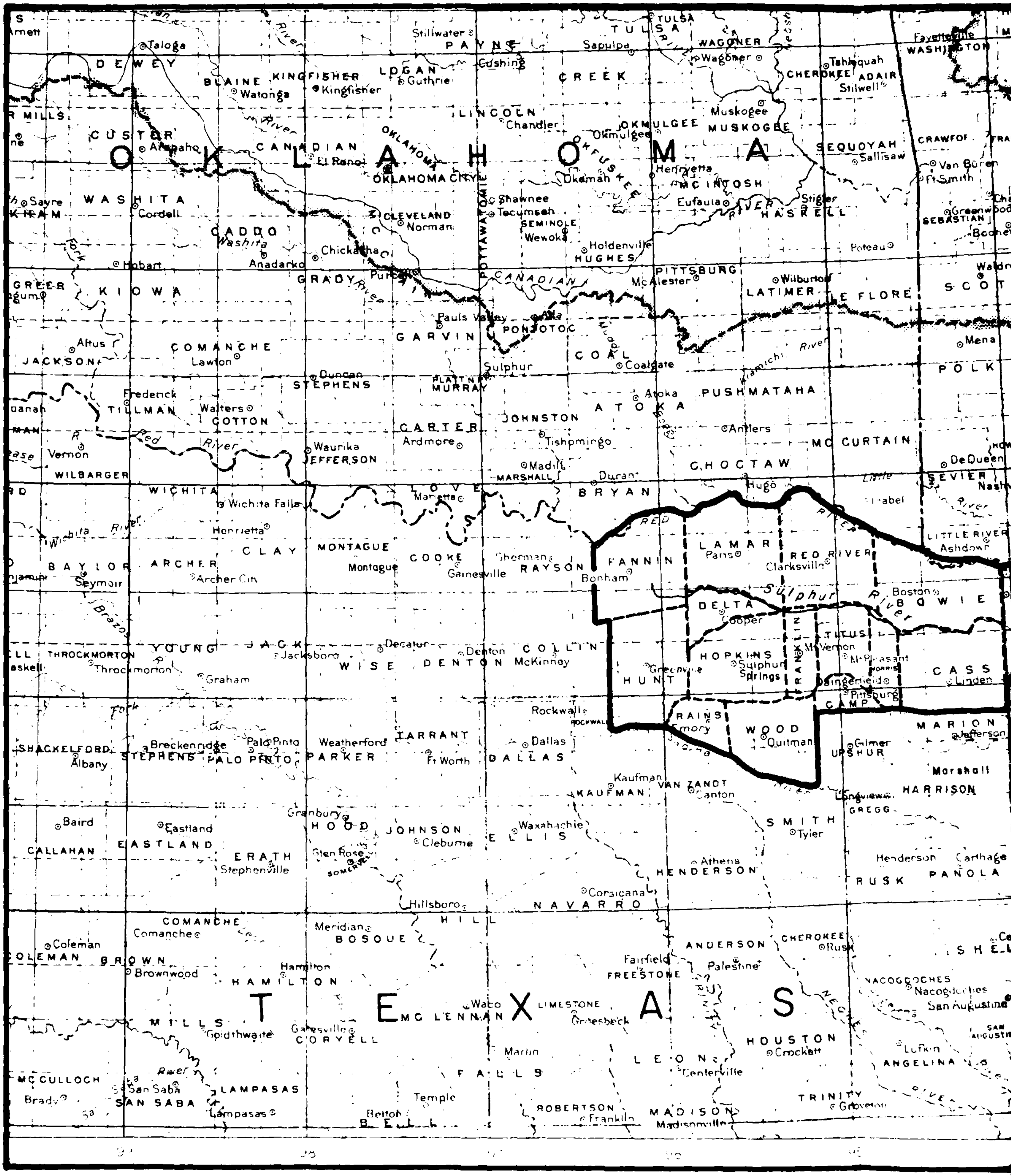
RESERVOIR AND LEVEES
(RECOMMENDED PLAN)

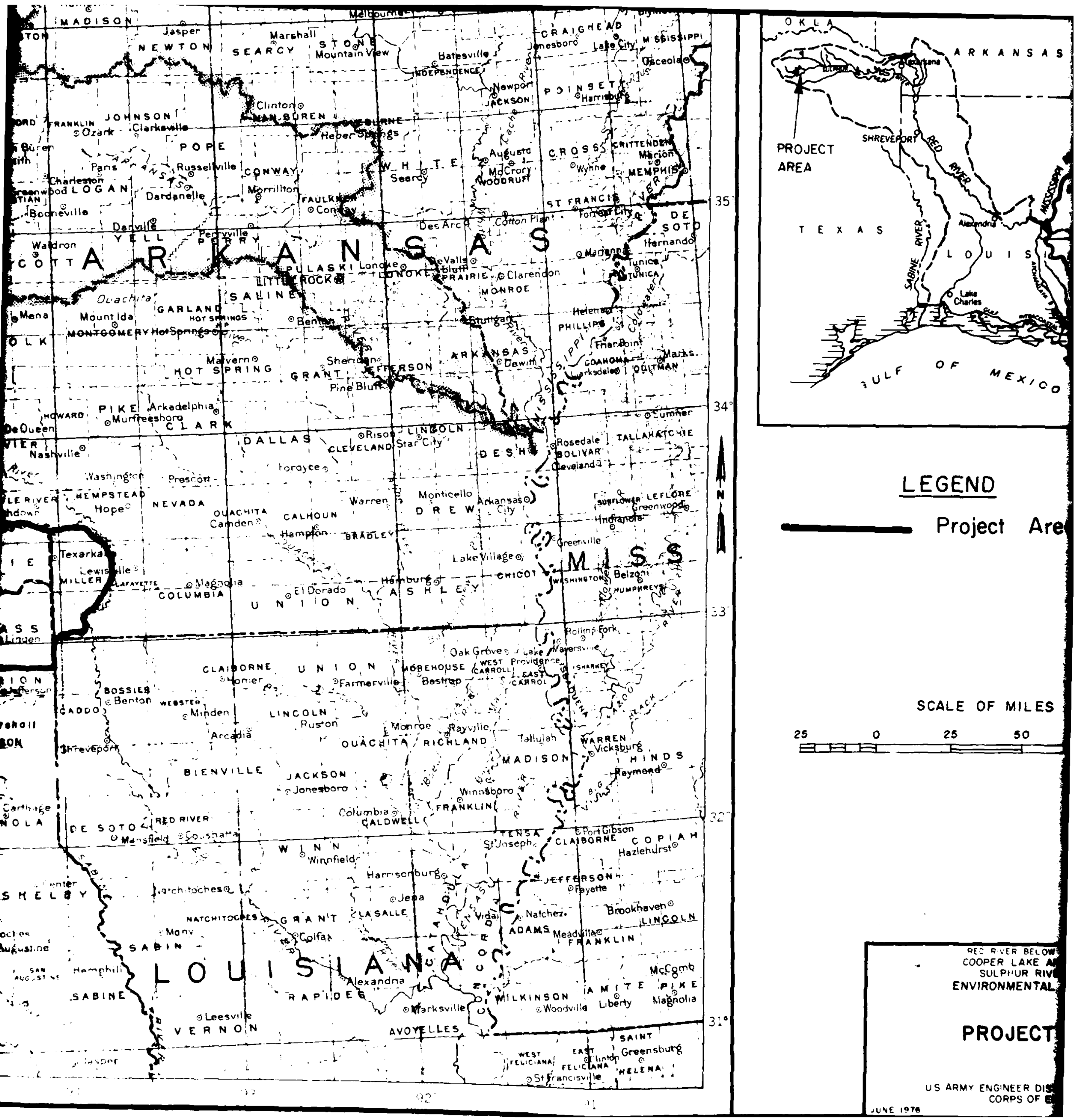
U S ARMY ENGINEER DISTRICT, NEW ORLEANS

CORPS OF ENGINEERS

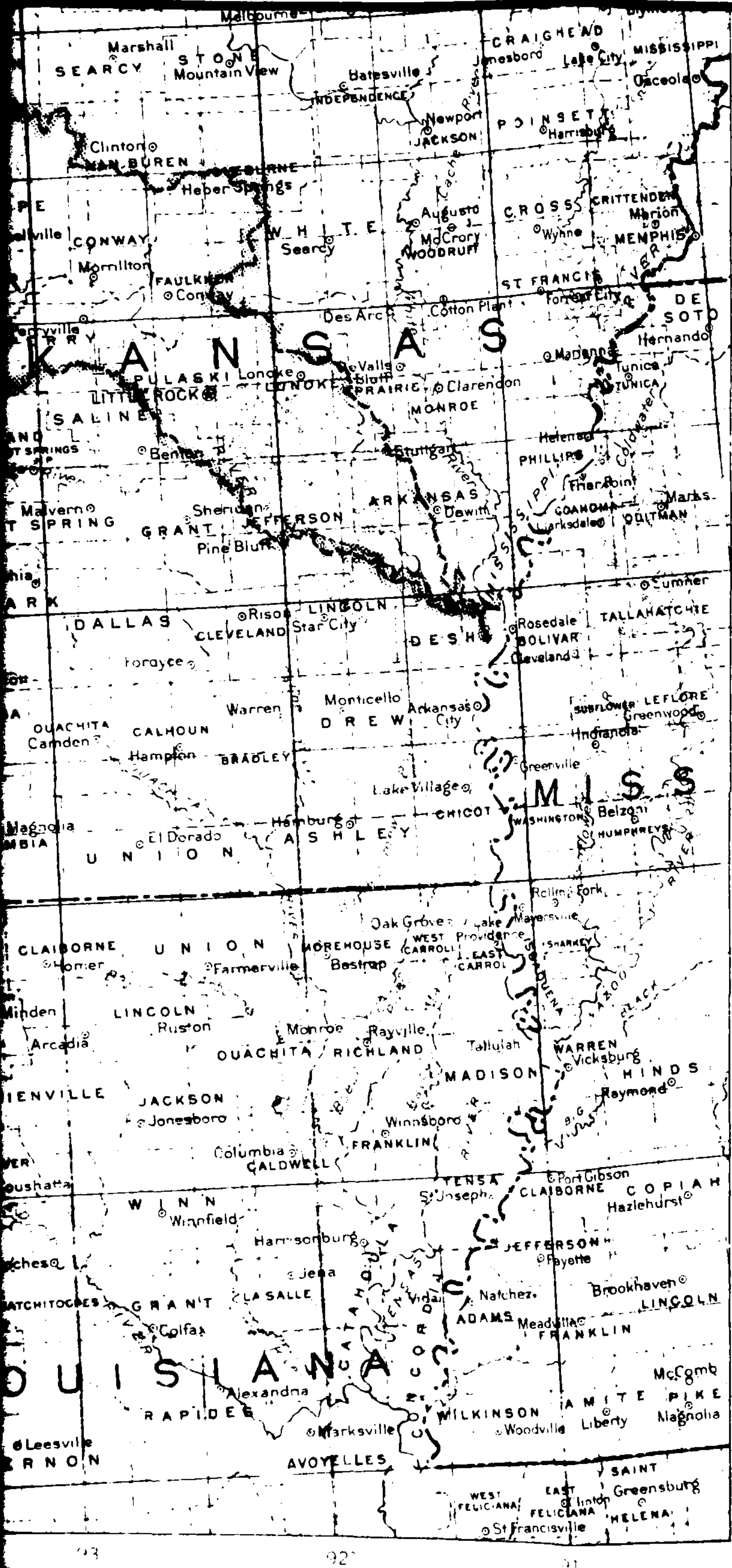
MARCH 1977 FILE NO. H-2-26659

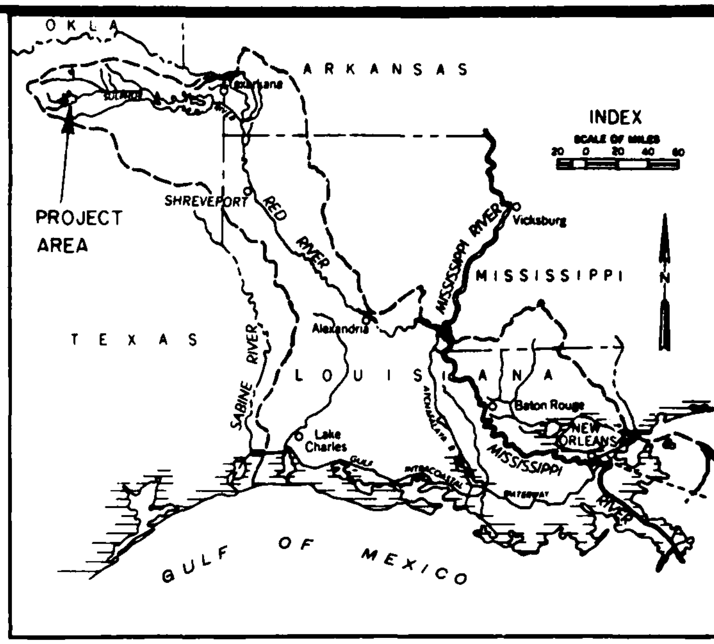
PLATE I-1


OKLAHOMA
TEXAS
DEWEY
Taloga
CUSTER
Arapaho
WASHITA
Cordell
BLAINE
Watonga
KINGFISHER
Kingfisher
LOGAN
Guthrie
PAYNE
Stillwater
Cushing
CREEK
Sapulpa
TULSA
WAGONER
Wagoner
CHEROKEE
Tahlequah
ADAIR
Stilwell
LINCOLN
Chandler
OKMULGEE
Okmulgee
MUSKOGEE
Muskogee
SEQUOYAH
Sallisaw
CRAWFORD
Van Buren
Ft Smith
SEBASTIAN
Greenwood
Booneville
CANADIAN
El Reno
OKLAHOMA
OKLAHOMA CITY
OKFUSKEE
Okemah
Henryetta
MC INTOSH
Eufaula
HASKELL
Stigler
Sayre
CLEVELAND
Norman
POTTAWATOMIE
Shawnee
Tecumseh
SEMINOLE
Wewoka
CADDO
Washita
Anadarko
Hobart
Chickasha
GRADY
Purcell
Holdenville
HUGHES
PITTSBURG
McAlester
Wilburton
LATIMER
LE FLORE
Poteau
Waldron
SCOTT
GREER
KIOWA
Pauls Valley
GARVIN
Ada
PONTOTOC
COAL
Coalgate
Mena
POLK
Altus
JACKSON
COMANCHE
Lawton
Duncan
STEPHENS
MURRAY
Sulphur
Atoka
ATOKA
PUSHMATAHA
Frederick
TILLMAN
Walters
COTTON
CARTER
Ardmore
JOHNSTON
Tishomingo
Antlers
MC CURTAIN
Vernon
WILBARGER
Waurika
JEFFERSON
Madill
MARSHALL
Durant
BRYAN
CHOCTAW
Hugo
De Queen
SEVIER
Nashville
WICHITA
Wichita Falls
LOVE
Marietta
Red River
Canadian
Henrietta
CLAY
MONTAGUE
Montague
COOKE
Gainesville
Sherman
GRAYSON
FANNIN
Bonham
LAMAR
Paris
RED RIVER
Clarksville
LITTLE RIVER
Ashdown
BAYLOR
Seymour
ARCHER
Archer City
DELTA
Cooper
Sulphur River
BOWIE
Boston
YOUNG
JACK
Jacksboro
Decatur
WISE
Denton
DENTON
COLLIN
McKinney
THROCKMORTON
Throckmorton
Graham
HUNT
Greenville
HOPKINS
Sulphur Springs
FRANKLIN
Mt Vernon
TITUS
Mt Pleasant
MORRIS
Daingerfield
Pittsburg
CAMP
CASS
Linden
Rockwall
ROCKWALL
RAINS
Emory
WOOD
Quitman
MARION
Jefferson
SHACKELFORD
Albany
Breckenridge
STEPHENS
Palo Pinto
PALO PINTO
Weatherford
PARKER
TARRANT
Ft Worth
Dallas
DALLAS
Gilmer
UPSHUR
Marshall
HARRISON
Kaufman
KAUFMAN
VAN ZANDT
Canton
Longview
GREGG
Baird
CALLAHAN
Eastland
EASTLAND
Granbury
HOOD
JOHNSON
Cleburne
Waxahachie
ELLIS
SMITH
Tyler
ERATH
Stephenville
Glen Rose
SOMERVELL
Athens
HENDERSON
Henderson
Carthage
RUSK
PANOLA
Corsicana
NAVARRO
Hillsboro
HILL
COMANCHE
Comanche
Meridian
BOSQUE
Coleman
COLEMAN
BROWN
Brownwood
ANDERSON
CHEROKEE
Rusk
Fairfield
FREESTONE
Palestine
SHELBY
Hamilton
HAMILTON
Waco
MC LENNAN
LIMESTONE
Groesbeck
NACOGDOCHES
Nacogdoches
San Augustine
SAN AUGUSTINE
MILLS
Goldthwaite
Gatesville
CORYELL
HOUSTON
Crockett
Lufkin
ANGELINA
Marlin
LEON
Centerville
FALLS
MC CULLOCH
Brady
San Saba
SAN SABA
LAMPASAS
Lampasas
Temple
Belton
BELL
ROBERTSON
Franklin
MADISON
Madisonville
TRINITY
Groveton



ARKANSAS
LOUISIANA
PROJECT AREA
TEXAS
GULF OF MEXICO
LEGEND
Project Are
SCALE OF MILES
25 0 25 50
RED RIVER BELOW
COOPER LAKE A
SULPHUR RIV
ENVIRONMENTAL
PROJECT
US ARMY ENGINEER DIS
CORPS OF E
JUNE 1976





LEGEND

Project Area

SCALE OF MILES

25 0 25 50 75 100

RED RIVER BELOW DENISON DAM
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
ENVIRONMENTAL STATEMENT

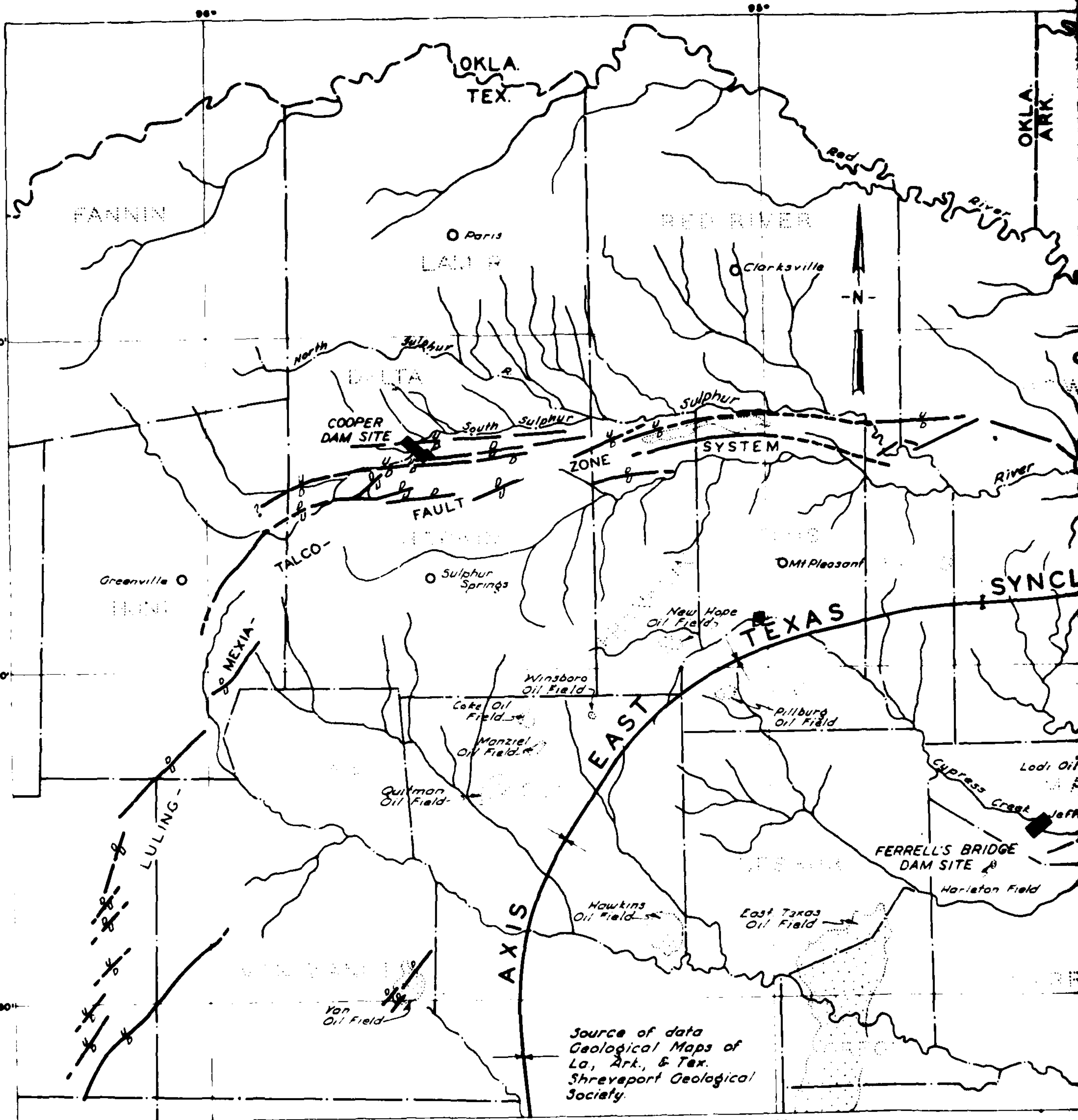
PROJECT AREA

US ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JUNE 1976

FILE NO. H-2-27561

PLATE II-1

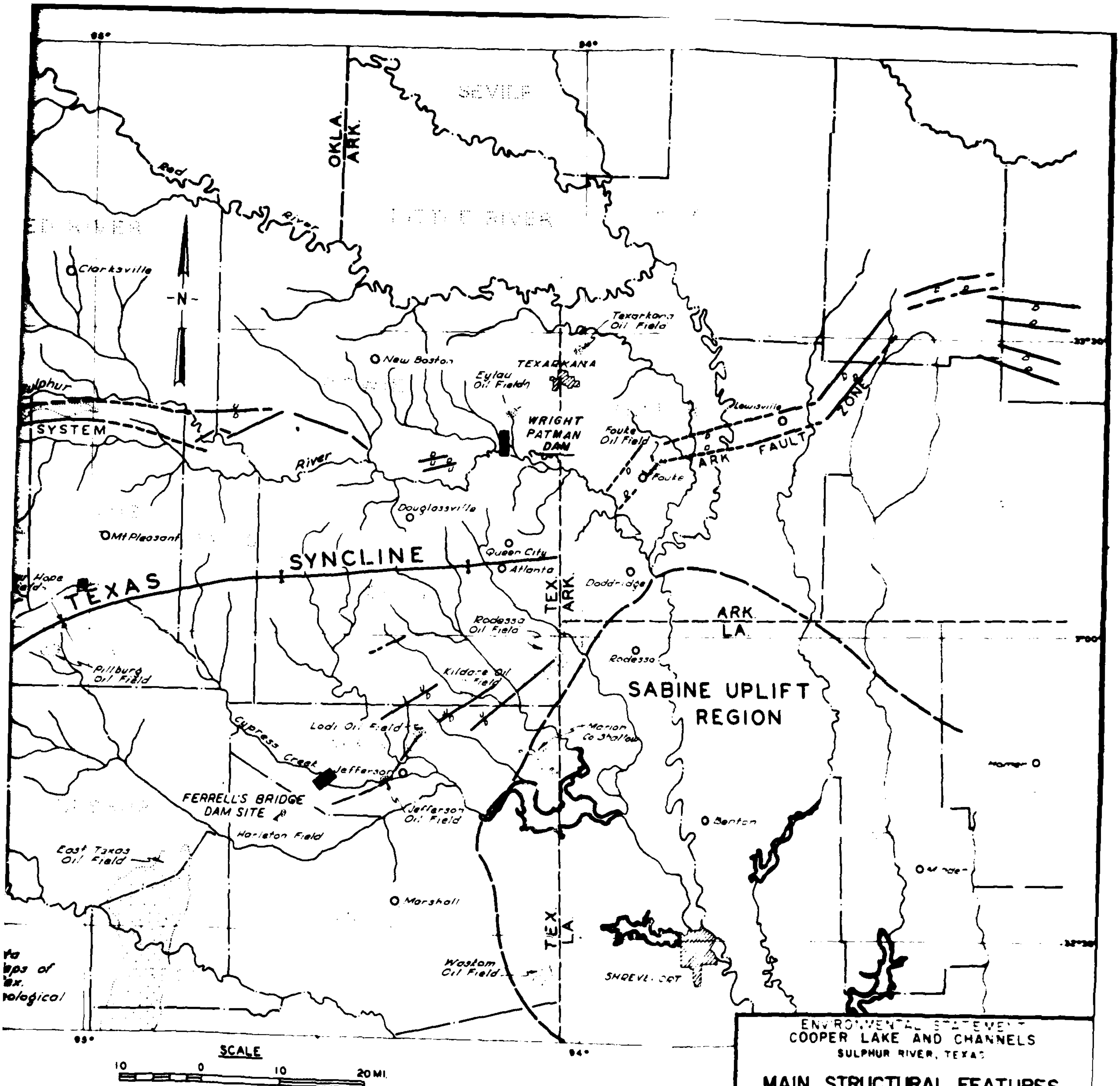


LEGEND

(D) DOWN / (U) UP - FAULTS

- SYNCLINE - ARROW INDICATES DIRECTION OF DIP OF BEDS

- OIL FIELD

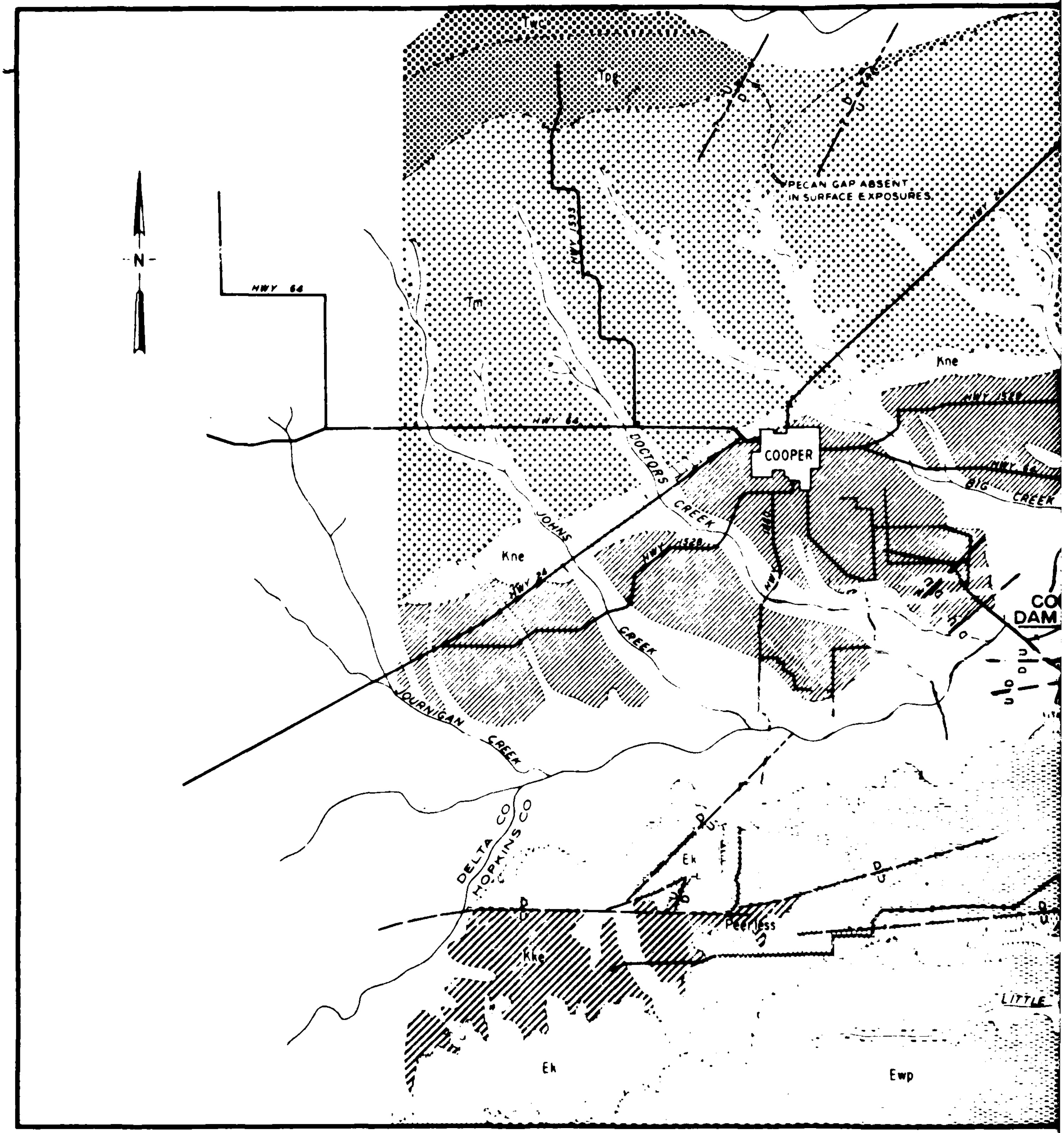


ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS

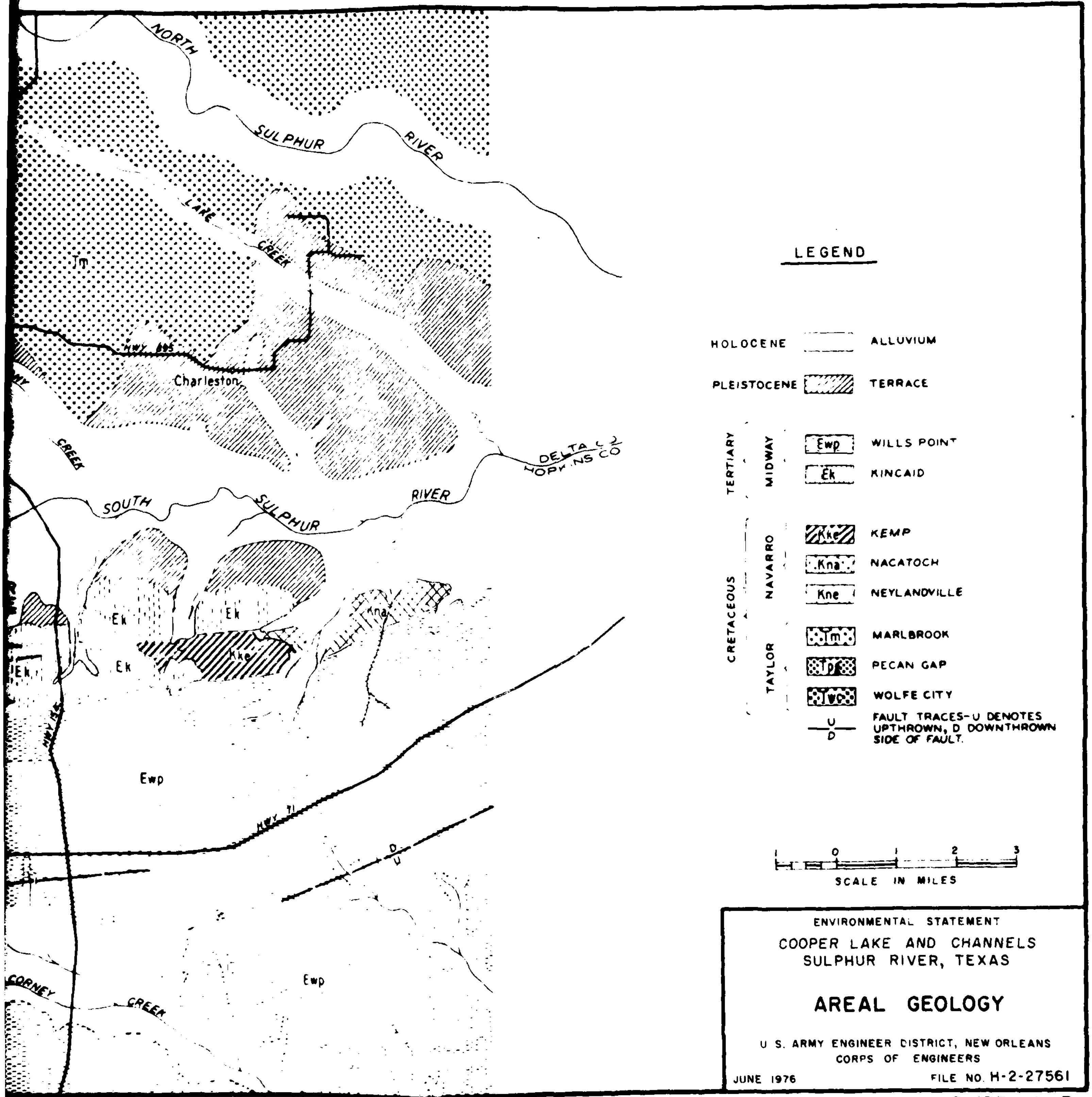
MAIN STRUCTURAL FEATURES AND OIL FIELDS N.E. TEX., N.W. LA. AND S.W. ARK

U.S. ARMY ENGINEER DISTRICT, NEW OR[illegible]
CORPS OF ENGINEERS

JUNE 1976 FILE NO. H-2-27561



N
HWY 64
Twc
Tpg
Tm
PECAN GAP ABSENT IN SURFACE EXPOSURES.
HWY 24
Kne
HWY 1528
COOPER
DOCTORS CREEK
JOHNS CREEK
BIG CREEK
JOURNIGAN CREEK
DELTA CO
HOPKINS CO
Ek
Peerless
Kke
LITTLE
Ewp
U
D



ENVIRONMENTAL STATEMENT

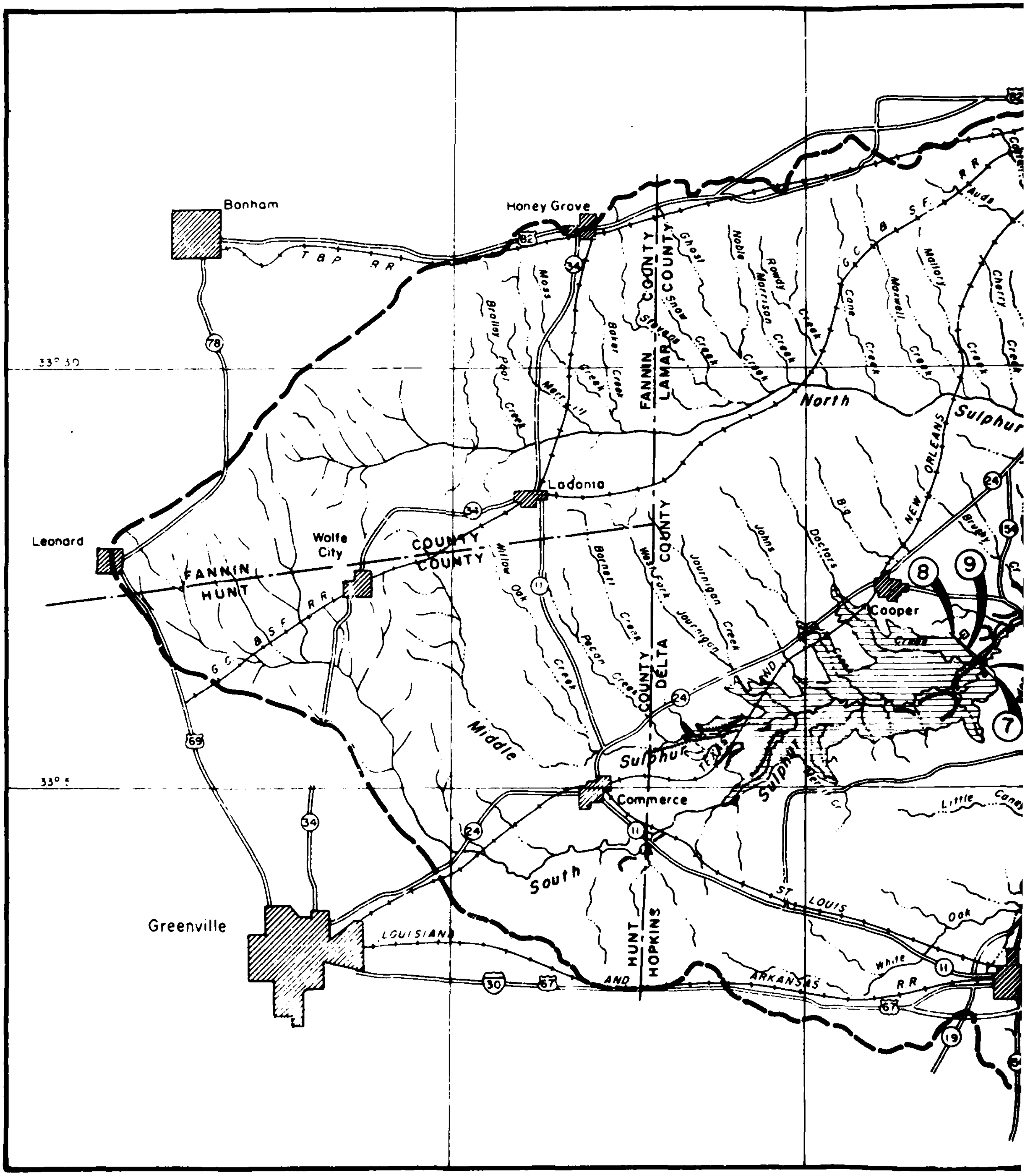
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS

AREAL GEOLOGY

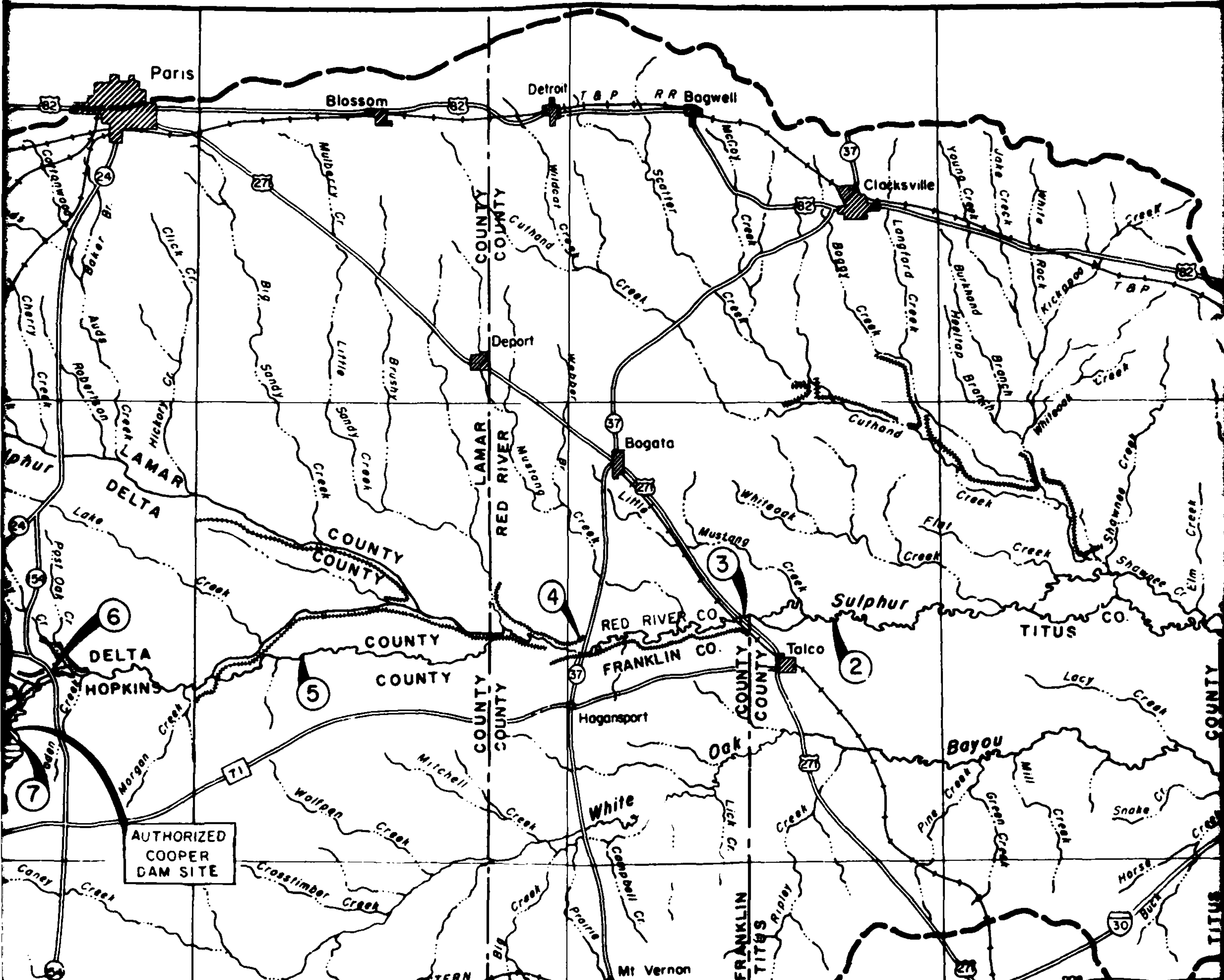
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JUNE 1976 FILE NO. H-2-27561

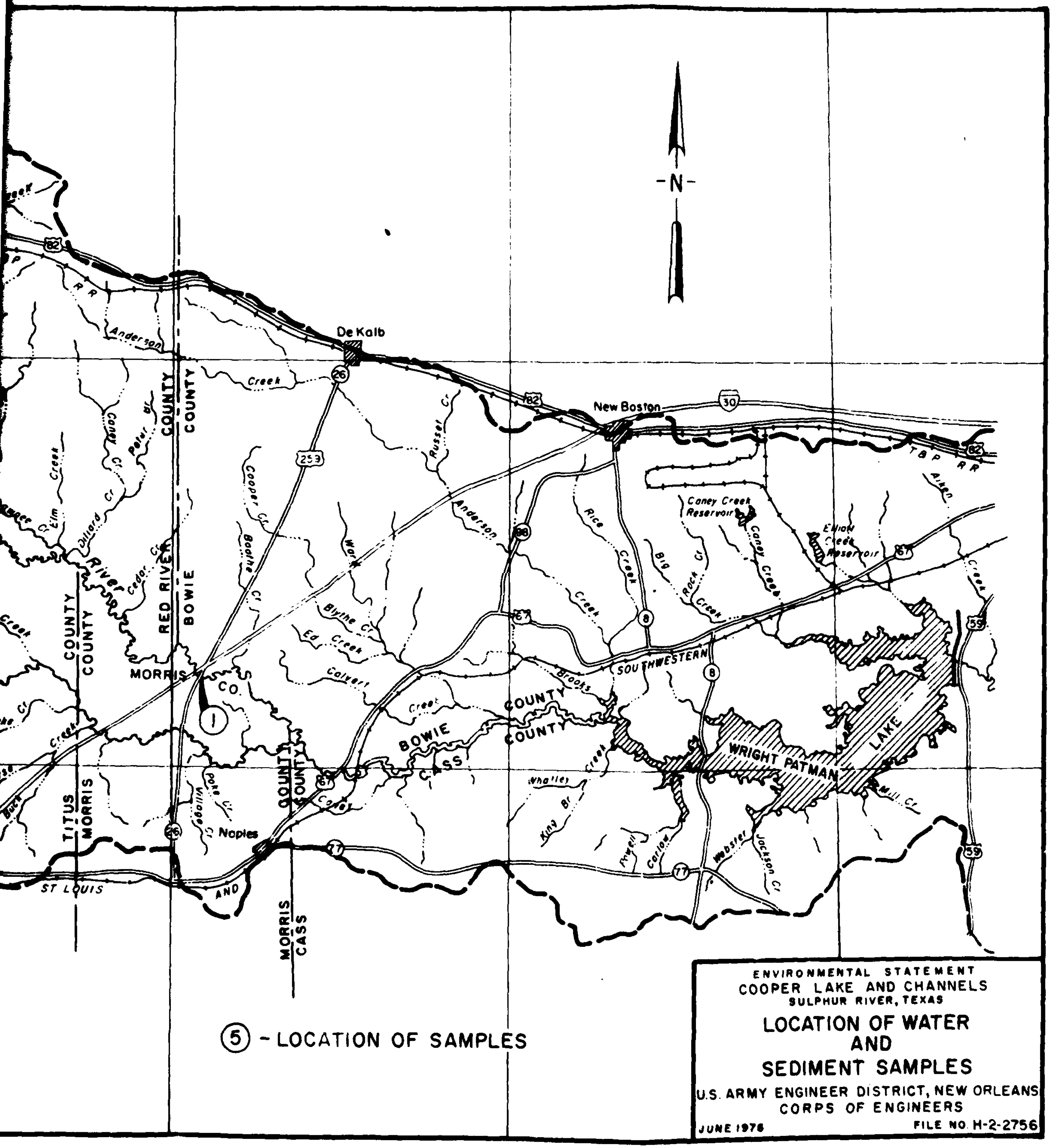
PLATE II - 3



Bonham
Honey Grove
Leonard
Wolfe City
Ladonia
Cooper
Commerce
Greenville
FANNIN COUNTY
LAMAR COUNTY
FANNIN COUNTY
HUNT COUNTY
COUNTY DELTA
HUNT
HOPKINS
T B P R R
G C & S F R R
NEW ORLEANS
TEXAS AND
ST LOUIS
LOUISIANA AND ARKANSAS R R
North Sulphur
Middle Sulphur
South Sulphur
Brollar Pool Creek
Moss
Baker Creek
Merrill Creek
Stevens Creek
Ghost
Noble
Rowdy
Morrison Creek
Cane Creek
Maxwell Creek
Mallory
Cherry Creek
Willow Oak Creek
Barnett Creek
West Fork Journigan Creek
Journigan Creek
Johns
Doctors
Big
Pecan Creek
Brushy
Little Caney
White Oak
33° 30
8
9
7
82
34
78
24
11
69
30
67
19



Paris
Blossom
Detroit
T & P R R
Bagwell
Clarksville
Deport
Bogata
Talco
Hagansport
Mt Vernon
Mount Pleasant
Sulphur Springs
LAMAR COUNTY
RED RIVER COUNTY
DELTA COUNTY
HOPKINS COUNTY
FRANKLIN COUNTY
TITUS COUNTY
RED RIVER CO.
FRANKLIN CO.
TITUS CO.
Sulphur
White Oak Bayou
Cuthand Creek
Mustang Creek
Whiteoak Creek
Flat Creek
Shawnee Creek
Lacy Creek
Wolfpen Creek
Crosstimber Creek
Coney Creek
Mitchell Creek
Campbell Cr.
Big Sandy Creek
Little Sandy Creek
Brushy Creek
Mulberry Cr.
Scatter Creek
Boggy Creek
Longford Creek
Kickapoo Creek
Pine Creek
Green Creek
Mill Creek
Snake Cr.
Lake Creek
Post Oak Cr.
Morgan Creek
SOUTHWESTERN
AUTHORIZED COOPER DAM SITE
1
2
3
4
5
6
7



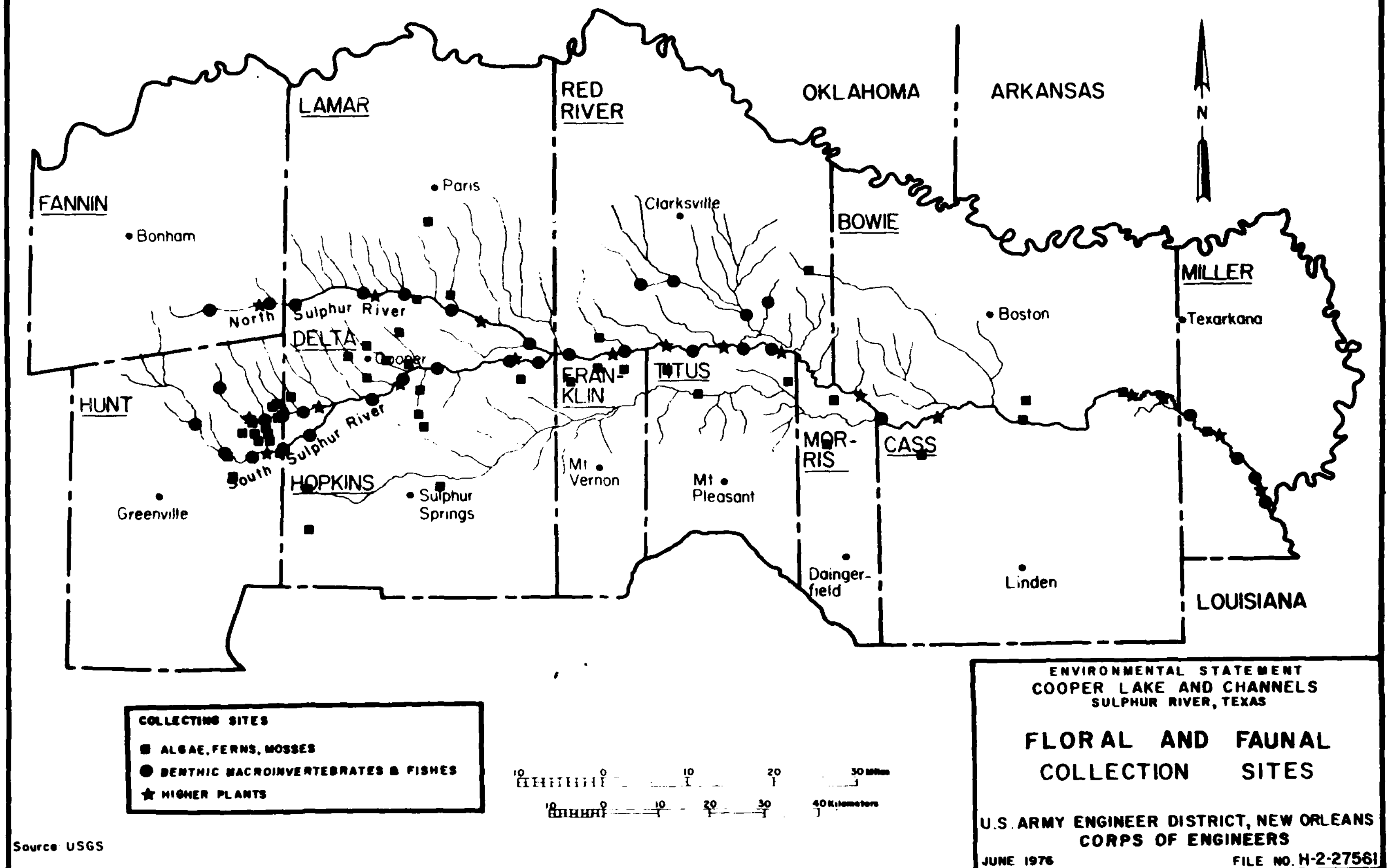
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS

LOCATION OF WATER AND SEDIMENT SAMPLES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JUNE 1976 FILE NO. H-2-2756

PLATE II-



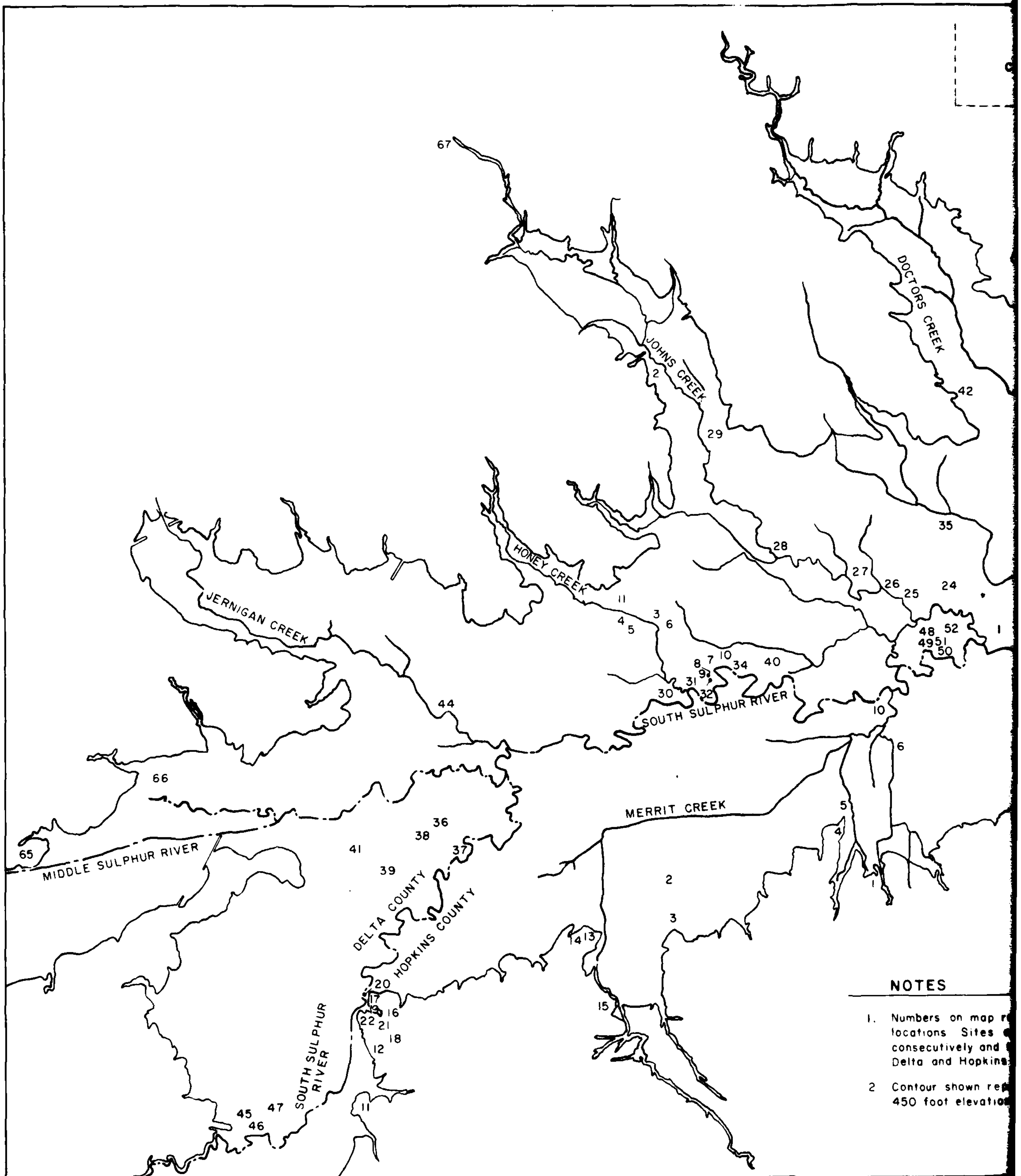
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS

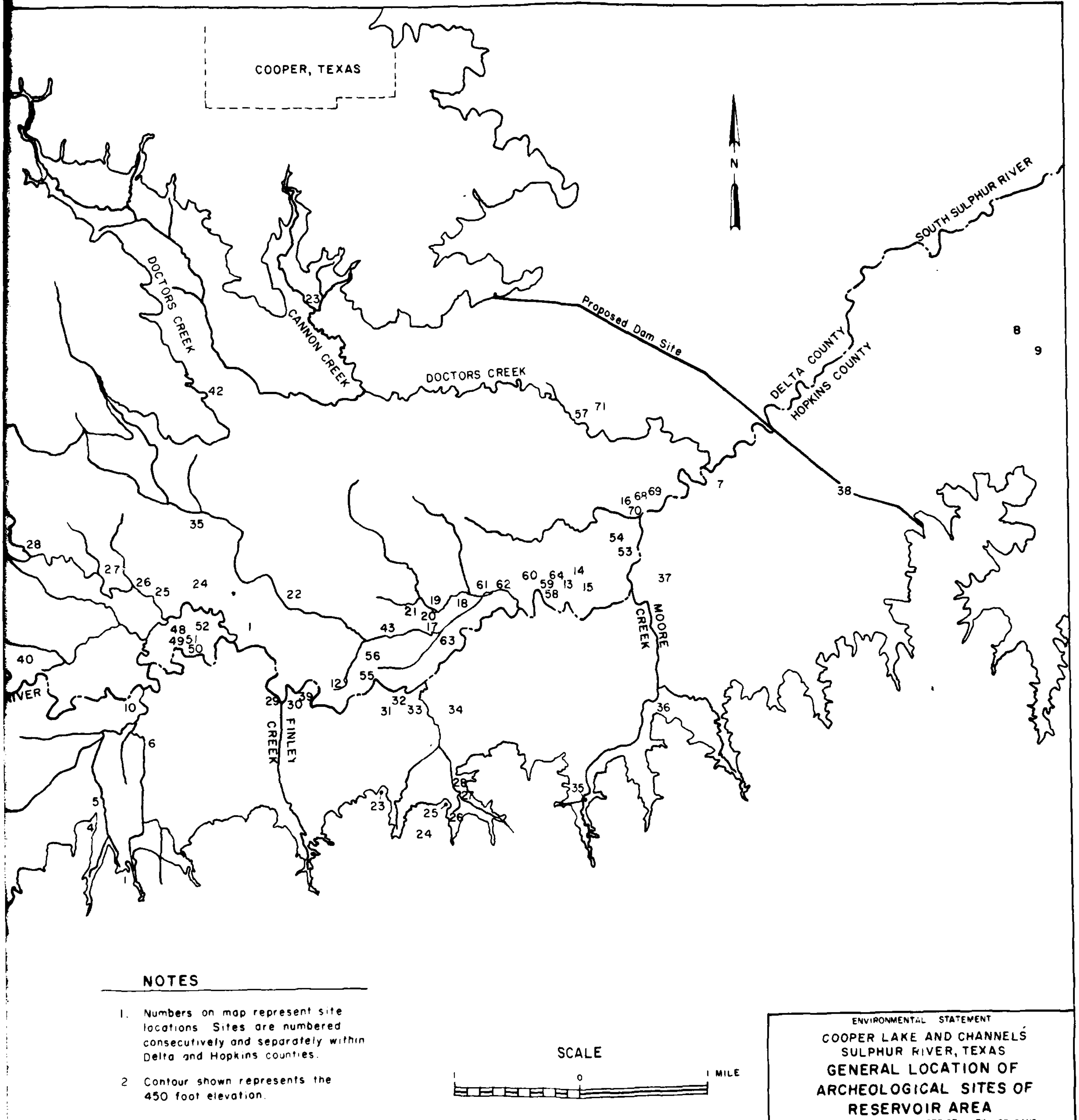
FLORAL AND FAUNAL COLLECTION SITES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JUNE 1976 FILE NO. H-2-27561

PLATE II-5


DOCTORS CREEK
JOHNS CREEK
HONEY CREEK
JERNIGAN CREEK
SOUTH SULPHUR RIVER
MERRIT CREEK
MIDDLE SULPHUR RIVER
DELTA COUNTY
HOPKINS COUNTY
SOUTH SULPHUR RIVER
NOTES
1. Numbers on map
locations Sites
consecutively and
Delta and Hopkins
2 Contour shown re
450 foot elevatio

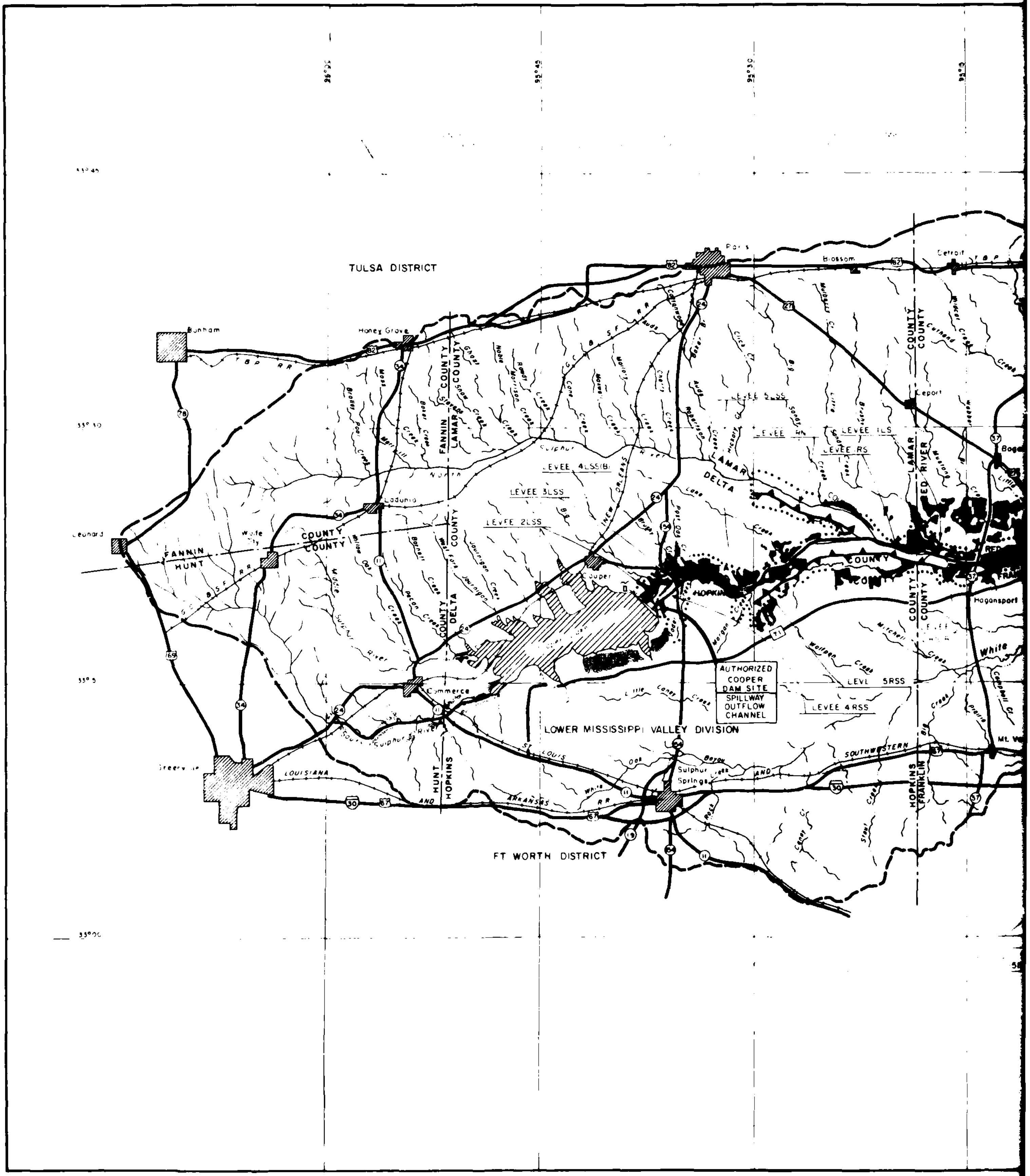


NOTES

1. Numbers on map represent site locations. Sites are numbered consecutively and separately within Delta and Hopkins counties.
2. Contour shown represents the 450 foot elevation.

ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
GENERAL LOCATION OF ARCHEOLOGICAL SITES OF RESERVOIR AREA
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JUNE 1976 FILE NO. H-2-27561

PLATE II-6



TULSA DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
AUTHORIZED
COOPER
DAM SITE
SPILLWAY
OUTFLOW
CHANNEL
Bonham
Honey Grove
Paris
Blossom
Detroit
Deport
Leonard
Ladonia
Wolfe City
Cooper
Commerce
Sulphur Springs
Hagansport
FANNIN
HUNT
LAMAR
DELTA
HOPKINS
FRANKLIN
LEVEE 5LSS
LEVEE 4LSS(B)
LEVEE 3LSS
LEVEE 2LSS
LEVEE 1LS
LEVEE 5RSS
LEVEE 4RSS
South Sulphur River
LOUISIANA
SOUTHWESTERN
White Oak

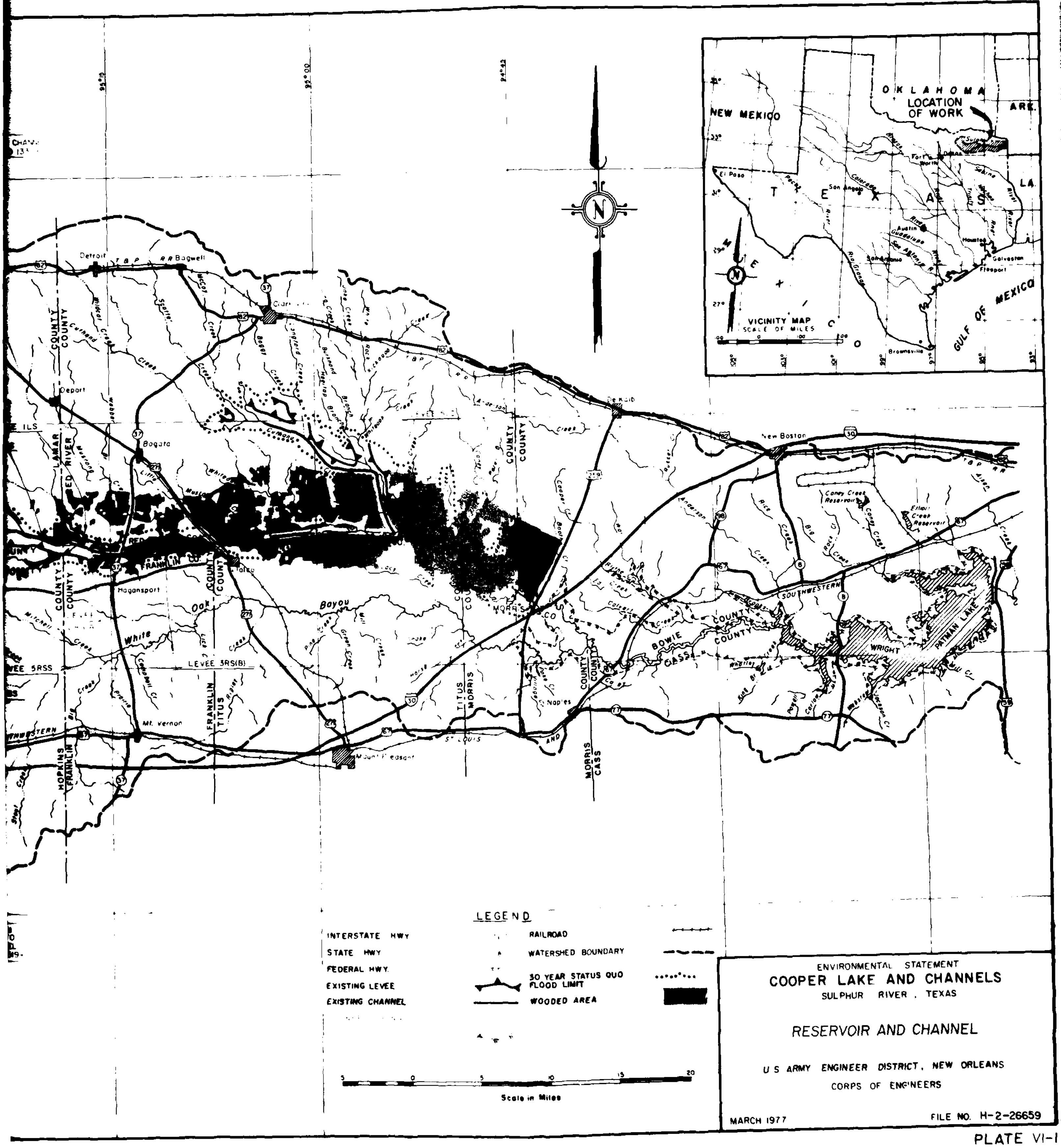
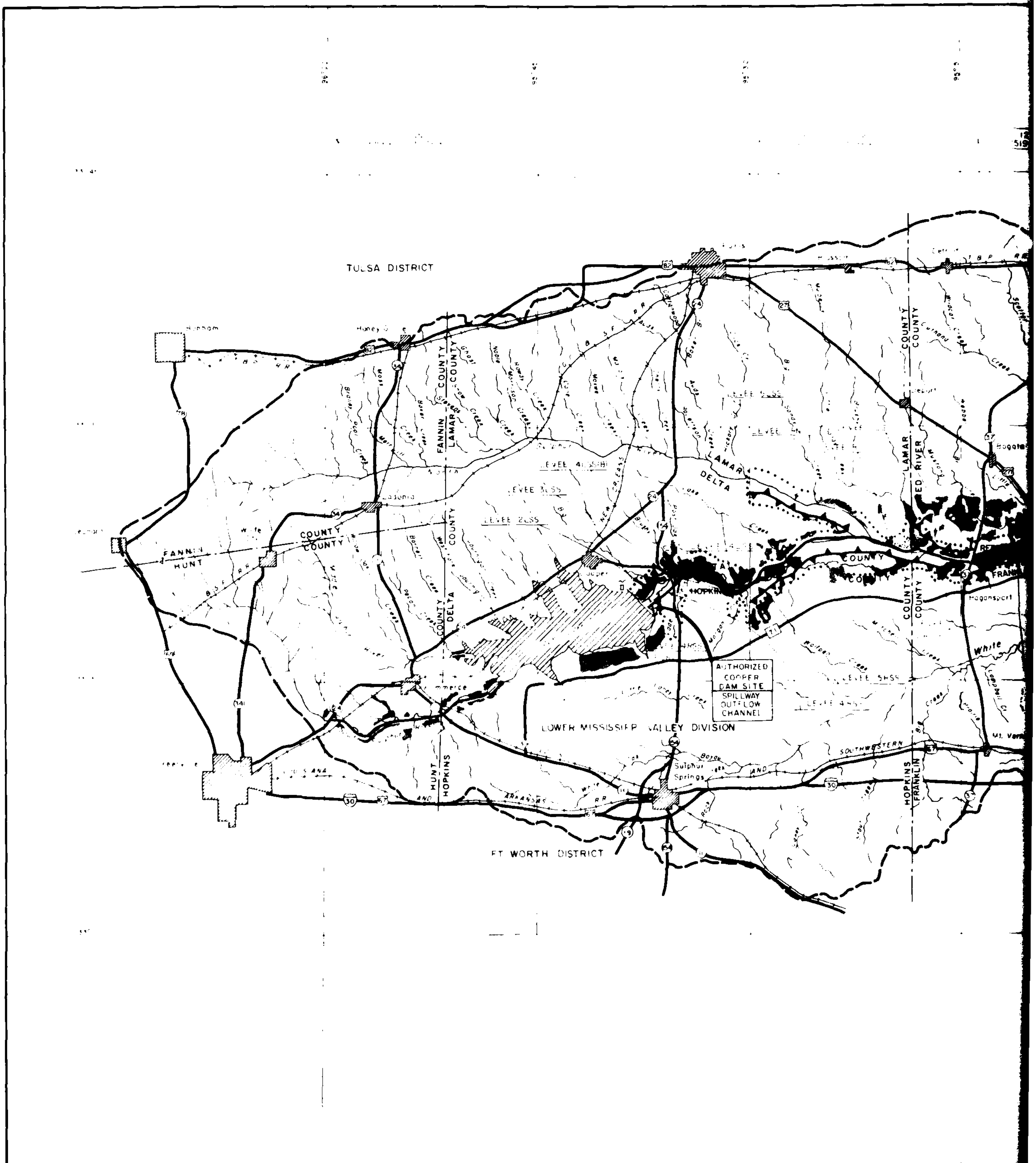

ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
RESERVOIR AND CHANNEL
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1977
FILE NO. H-2-26659
LEGEND
INTERSTATE HWY
STATE HWY
FEDERAL HWY
EXISTING LEVEE
EXISTING CHANNEL
RAILROAD
WATERSHED BOUNDARY
30 YEAR STATUS QUO FLOOD LIMIT
WOODED AREA
Scale in Miles
VICINITY MAP
SCALE OF MILES
OKLAHOMA
LOCATION OF WORK
NEW MEXICO
TEXAS
MEXICO
GULF OF MEXICO
Detroit
Bagwell
Clarksville
Deport
Bogata
Talco
Hagansport
Mt. Vernon
Mount Pleasant
De Kalb
New Boston
Naples
Morris
Wright Patman Lake
LEVEE 3RS(B)
LEVEE 5RSS

PLATE VI-1


TULSA DISTRICT
Paris
Honey Grove
Ladonia
FANNIN COUNTY
LAMAR COUNTY
COUNTY DELTA
HUNT
LEVEE 4(S)(B)
LEVEE 3(S)S
LEVEE 2(S)S
LAMAR
DELTA
HOPKINS
AUTHORIZED
COOPER
DAM SITE
SPILLWAY
OUTFLOW
CHANNEL
LOWER MISSISSIPPI VALLEY DIVISION
LEVEE 5HSS
LEVEE 4HSS
Sulphur
Springs
HUNT
HOPKINS
HOPKINS
FRANKLIN
Hagansport
White
Mt. Vernon
SOUTHWESTERN
FT WORTH DISTRICT

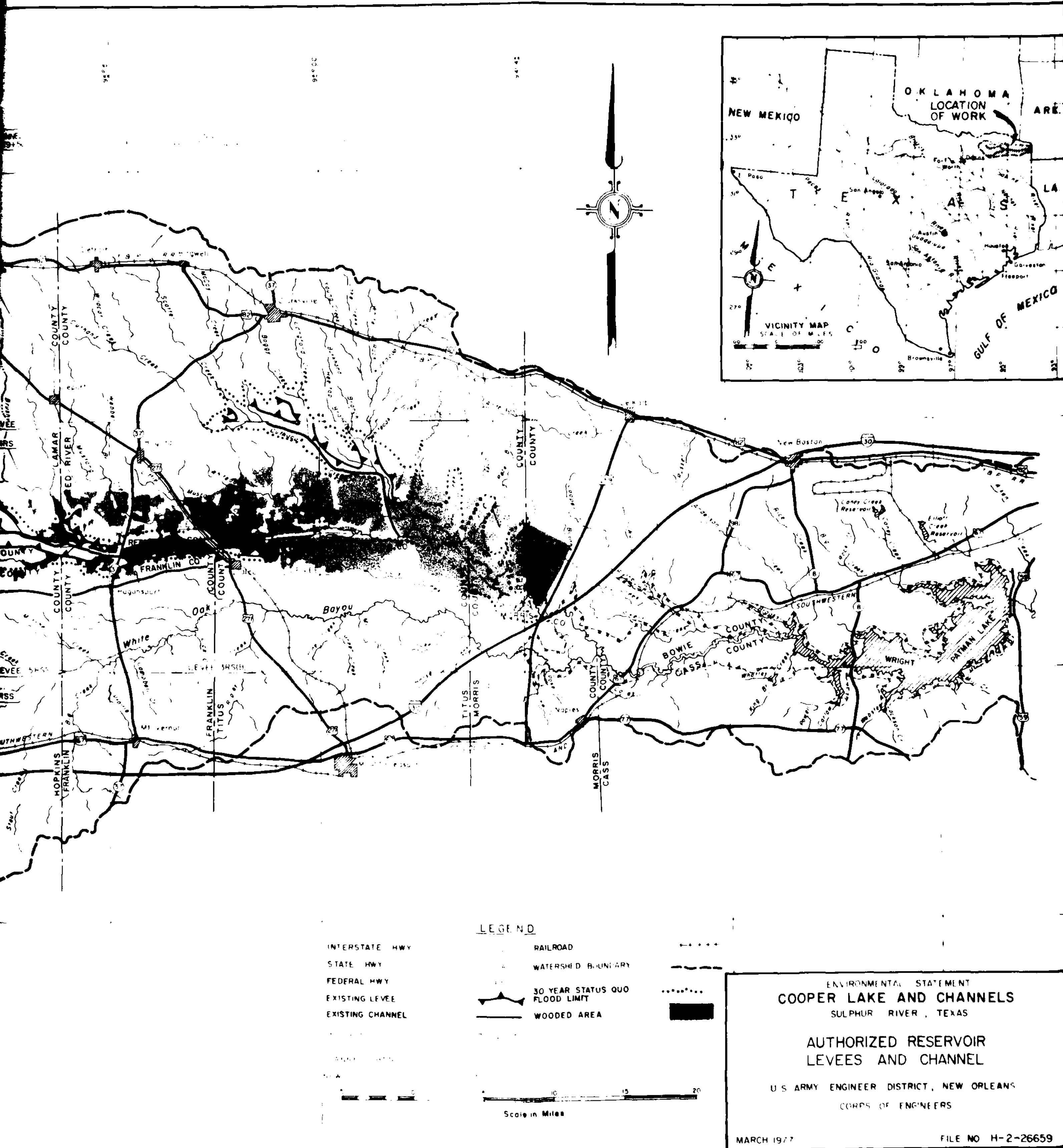
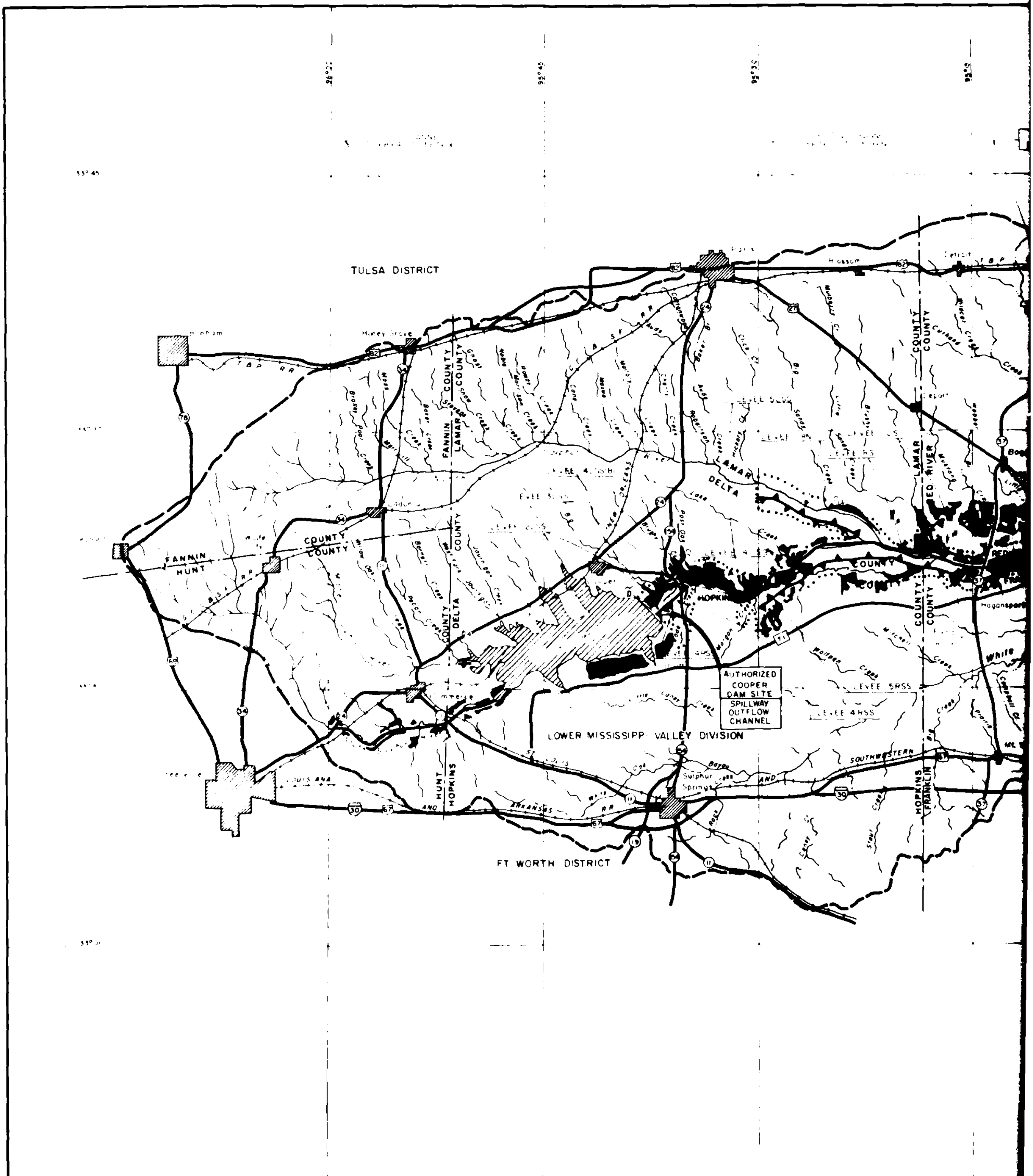
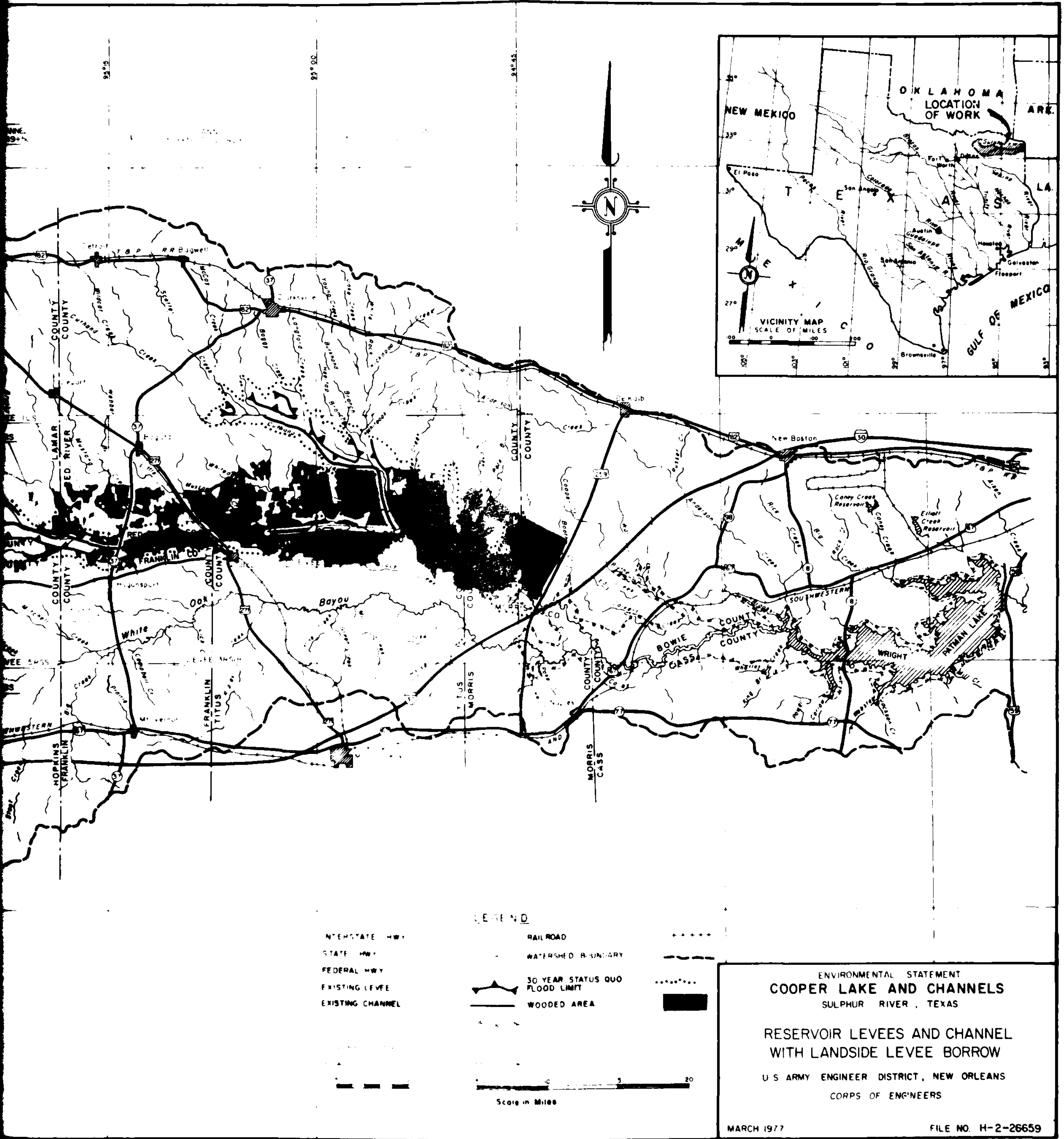

OKLAHOMA
LOCATION OF WORK
NEW MEXICO
TEXAS
MEXICO
GULF OF MEXICO
VICINITY MAP
SCALE OF MILES
New Boston
Naples
Mt. Vernon
Oak
Bayou
White
WRIGHT
PATMAN LAKE
BOWIE COUNTY
CASS COUNTY
FRANKLIN CO
LAMAR COUNTY
RED RIVER COUNTY
HOPKINS
FRANKLIN
TITUS
MORRIS
CASS
SOUTHWESTERN
LEGEND
INTERSTATE HWY
STATE HWY
FEDERAL HWY
EXISTING LEVEE
EXISTING CHANNEL
RAILROAD
WATERSHED BOUNDARY
30 YEAR STATUS QUO FLOOD LIMIT
WOODED AREA
Scale in Miles
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
AUTHORIZED RESERVOIR
LEVEES AND CHANNEL
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1977
FILE NO. H-2-26659

PLATE VI-2



TULSA DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
AUTHORIZED COOPER DAM SITE
SPILLWAY OUTFLOW CHANNEL
FANNIN COUNTY
HUNT COUNTY
LAMAR COUNTY
DELTA COUNTY
HOPKINS COUNTY
FRANKLIN COUNTY
RED RIVER COUNTY
LEVEE 5RSS
LEVEE 4RSS
Sulphur Springs
Honey Grove
SOUTHWESTERN
ARKANSAS



ENVIRONMENTAL STATEMENT

COOPER LAKE AND CHANNELS

SULPHUR RIVER, TEXAS

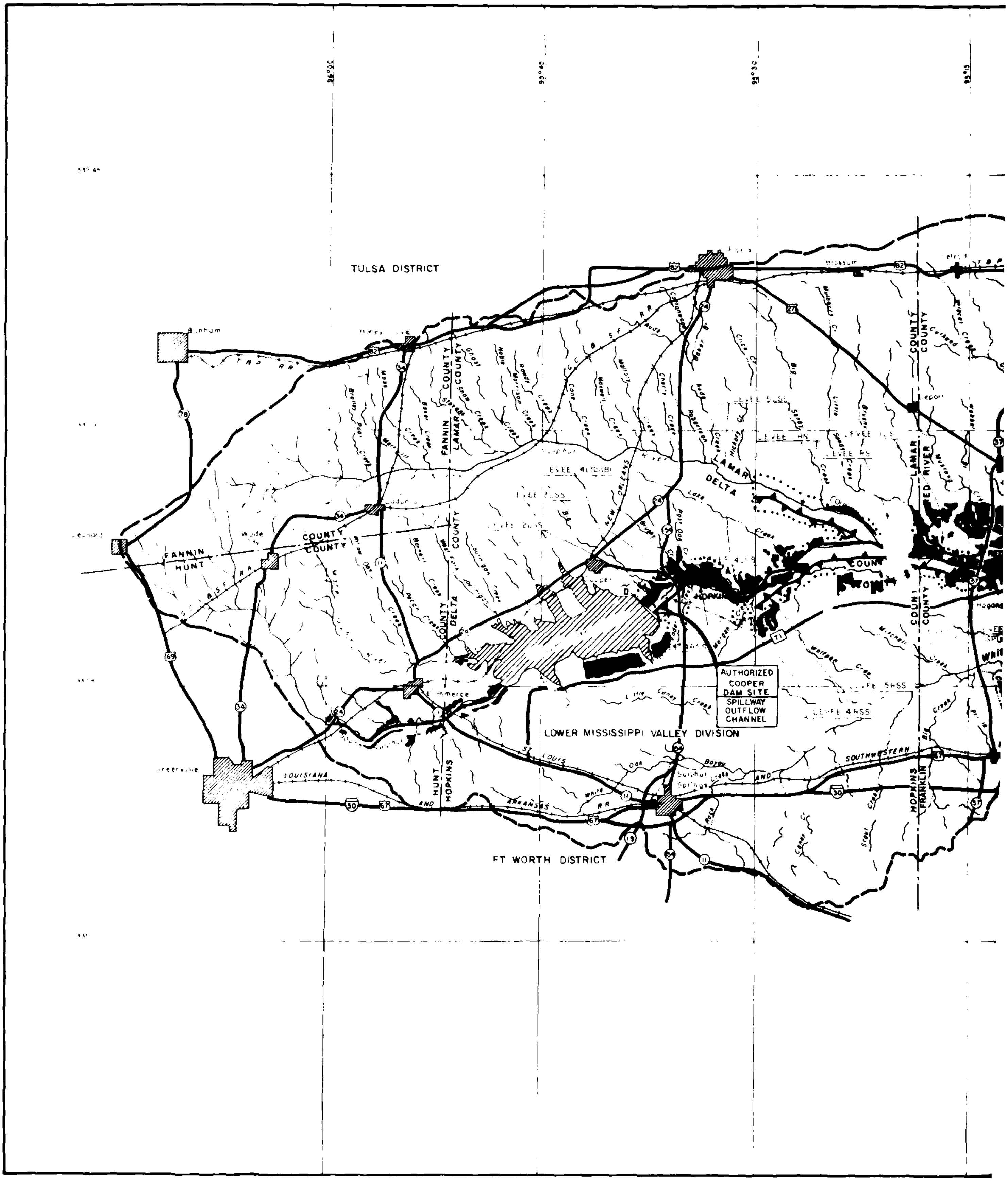
RESERVOIR LEVEES AND CHANNEL WITH LANDSIDE LEVEE BORROW

U S ARMY ENGINEER DISTRICT, NEW ORLEANS

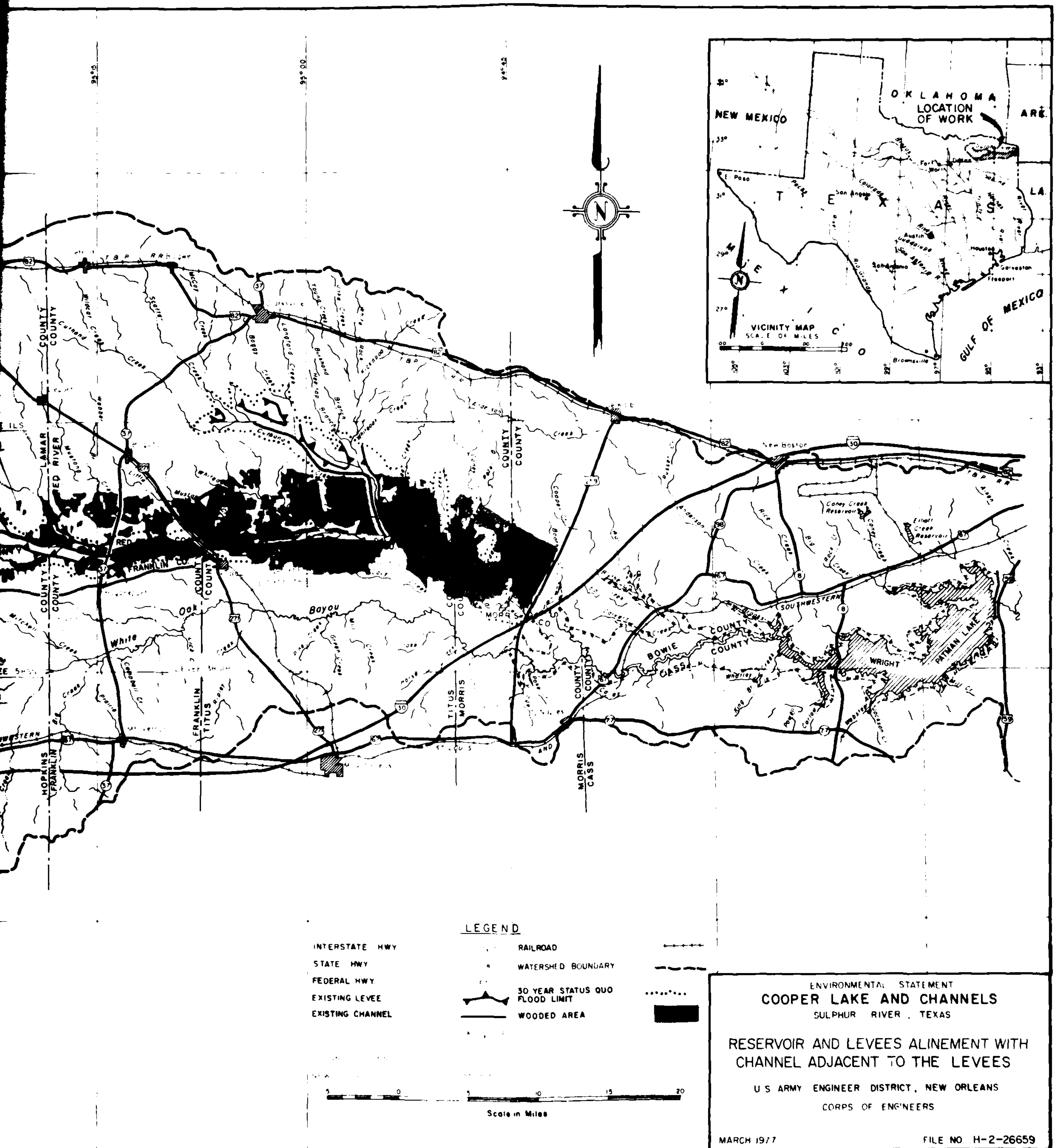
CORPS OF ENGINEERS

MARCH 1977 FILE NO. H-2-26659

PLATE VI-3

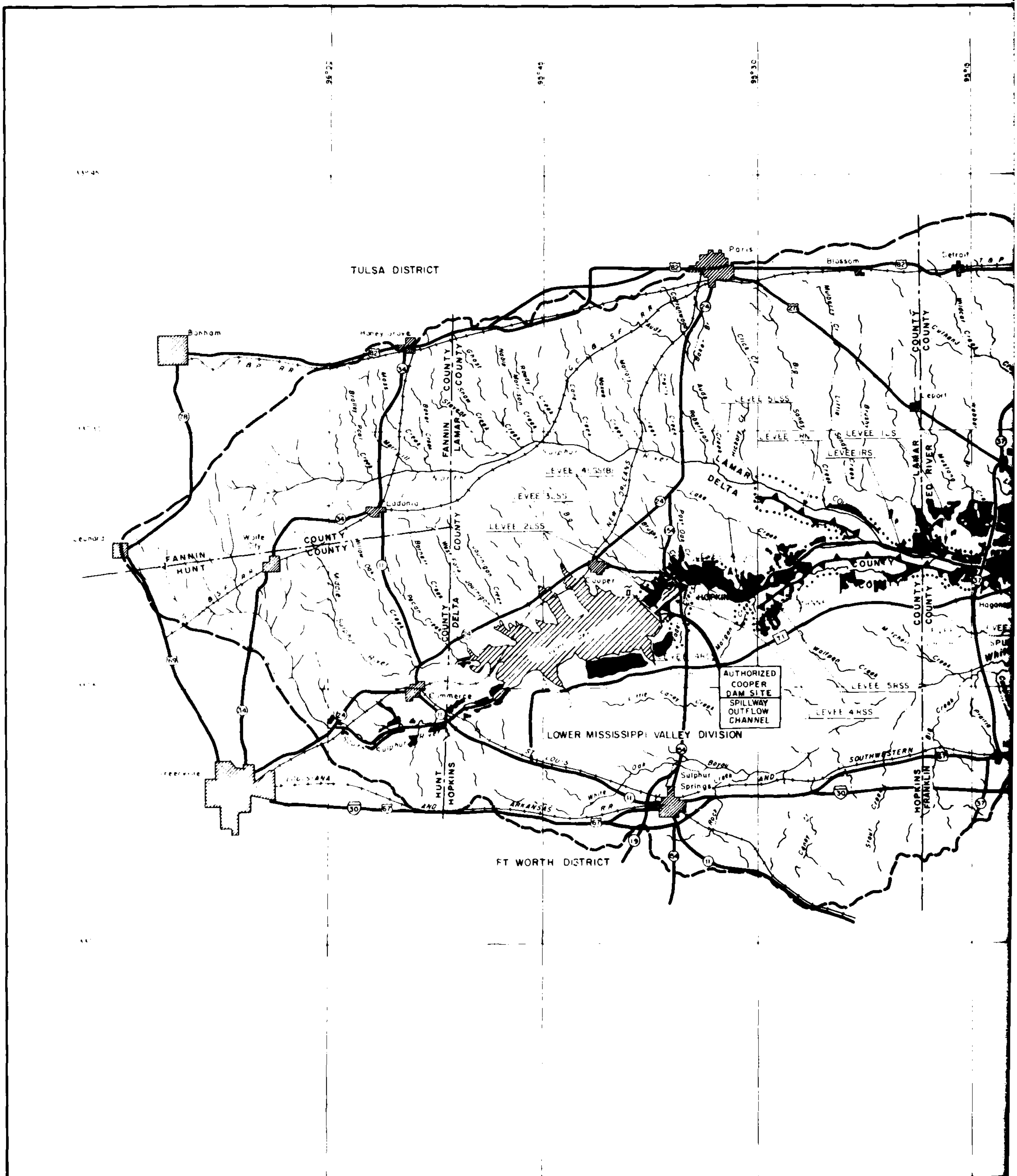


TULSA DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
AUTHORIZED
COOPER
DAM SITE
SPILLWAY
OUTFLOW
CHANNEL
FANNIN
HUNT
COUNTY
COUNTY
FANNIN COUNTY
LAMAR COUNTY
DELTA COUNTY
HUNT
HOPKINS
LAMAR
DELTA
RED RIVER COUNTY
LAMAR COUNTY
HOPKINS
FRANKLIN
Greenville
Commerce
Sulphur Springs
LOUISIANA
AND
ARKANSAS
RR
ST LOUIS
SOUTHWESTERN
NEW ORLEANS
White Oak Creek
Little Cypress Creek

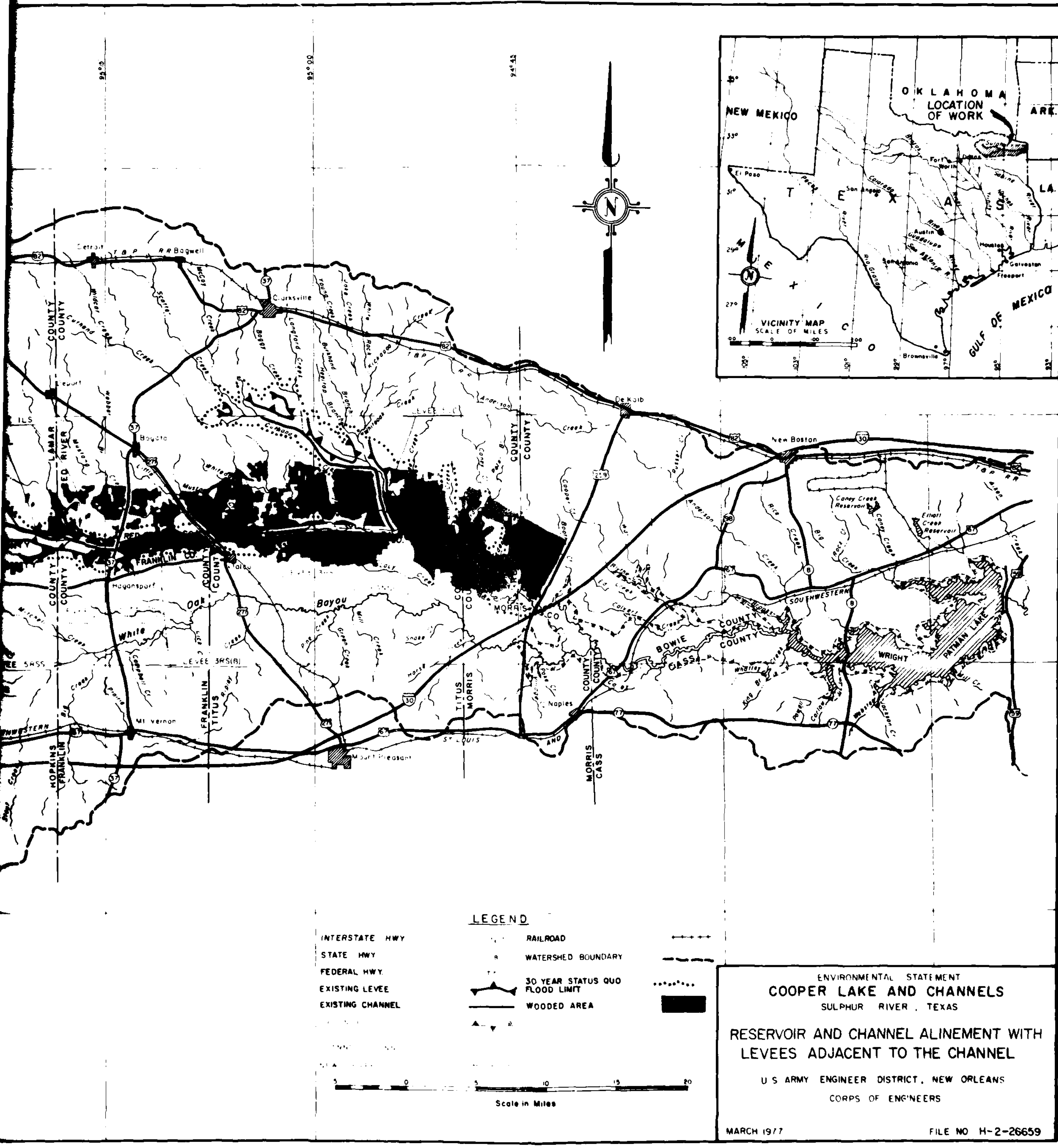


OKLAHOMA
LOCATION OF WORK
NEW MEXICO
ARK.
LA.
TEXAS
GULF OF MEXICO
VICINITY MAP
New Boston
Coney Creek Reservoir
Elliott Creek Reservoir
WRIGHT PATMAN LAKE
LAMAR COUNTY
RED RIVER COUNTY
FRANKLIN CO.
HOPKINS
FRANKLIN
TITUS
MORRIS
BOWIE COUNTY
CASS COUNTY
Bayou
White Oak
LEGEND
INTERSTATE HWY
STATE HWY
FEDERAL HWY
EXISTING LEVEE
EXISTING CHANNEL
RAILROAD
WATERSHED BOUNDARY
30 YEAR STATUS QUO FLOOD LIMIT
WOODED AREA
Scale in Miles
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
RESERVOIR AND LEVEES ALINEMENT WITH CHANNEL ADJACENT TO THE LEVEES
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1977
FILE NO. H-2-26659

PLATE VI-4



TULSA DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
AUTHORIZED
COOPER
DAM SITE
SPILLWAY
OUTFLOW
CHANNEL
Bonham
Honey Grove
Paris
Blossom
Detroit
Ladonia
Cooper
Commerce
Sulphur Springs
Leonard
FANNIN
HUNT
LAMAR
DELTA
HOPKINS
FRANKLIN
LEVEE 5LSS
LEVEE 1LS
LEVEE 1RS
LEVEE 4LSS(B)
LEVEE 3LSS
LEVEE 2LSS
LEVEE 5RSS
LEVEE 4RSS



ENVIRONMENTAL STATEMENT

COOPER LAKE AND CHANNELS

SULPHUR RIVER, TEXAS

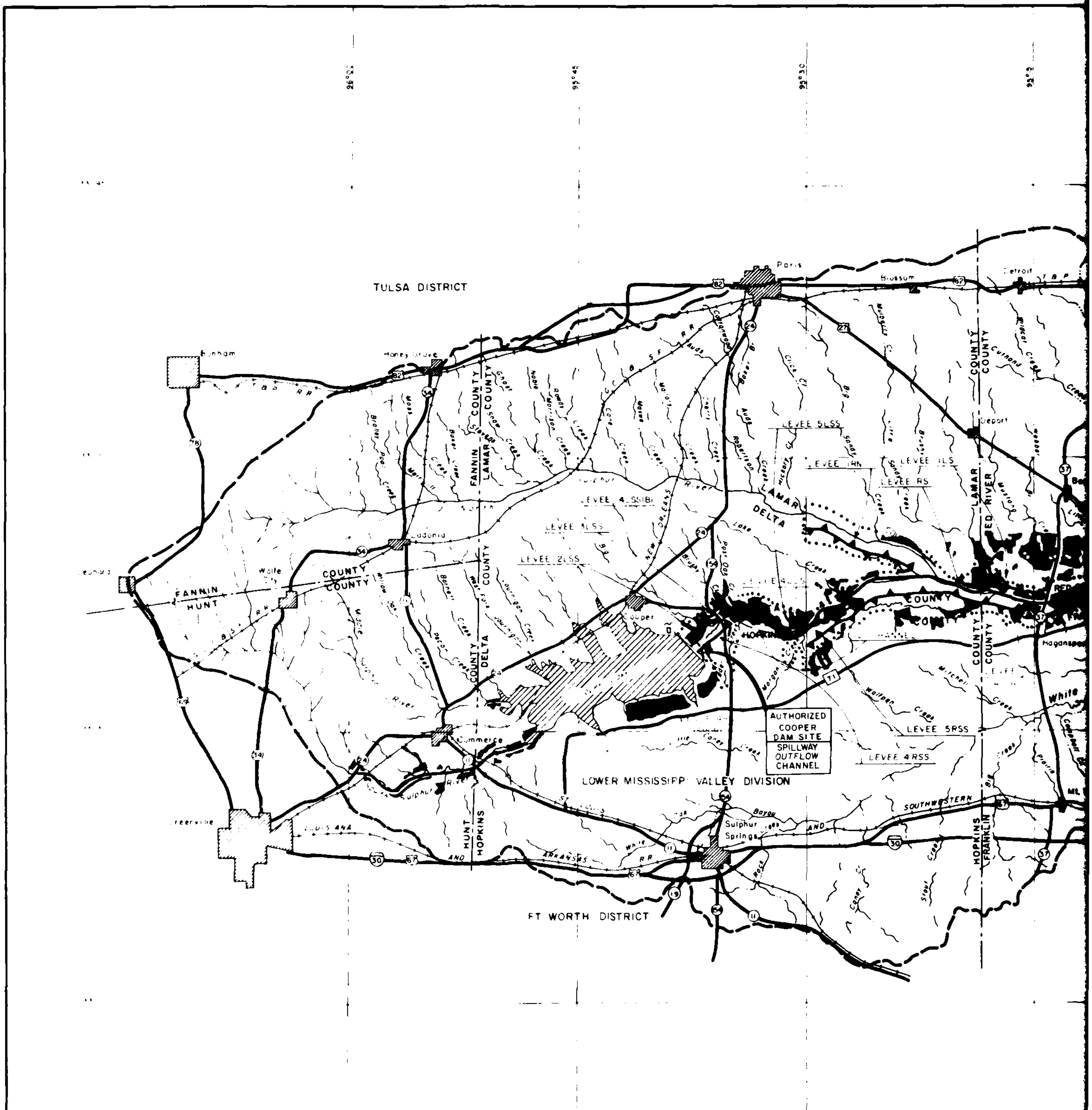
RESERVOIR AND CHANNEL ALINEMENT WITH LEVEES ADJACENT TO THE CHANNEL

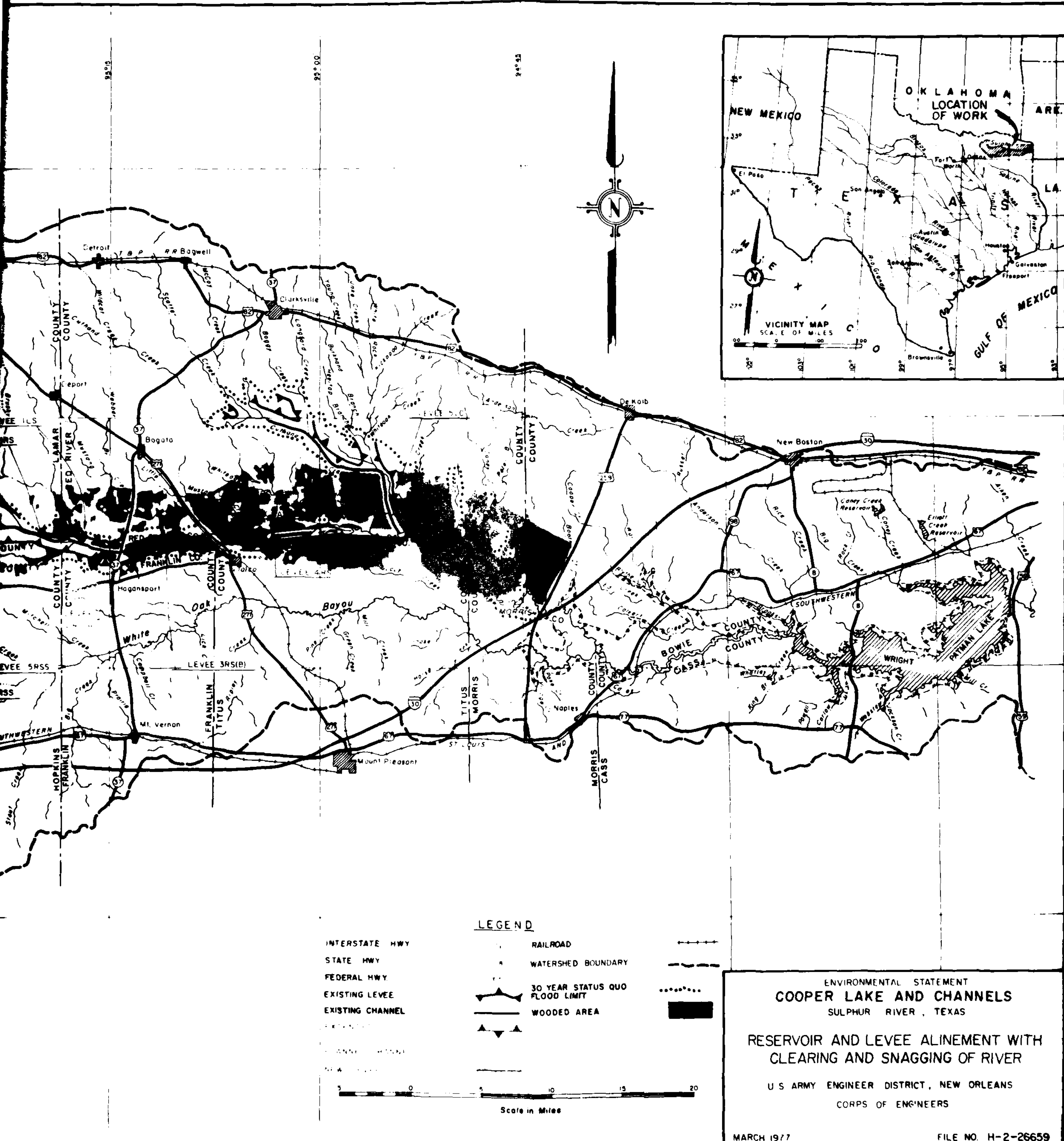
U S ARMY ENGINEER DISTRICT, NEW ORLEANS

CORPS OF ENGINEERS

MARCH 1977 FILE NO H-2-26659

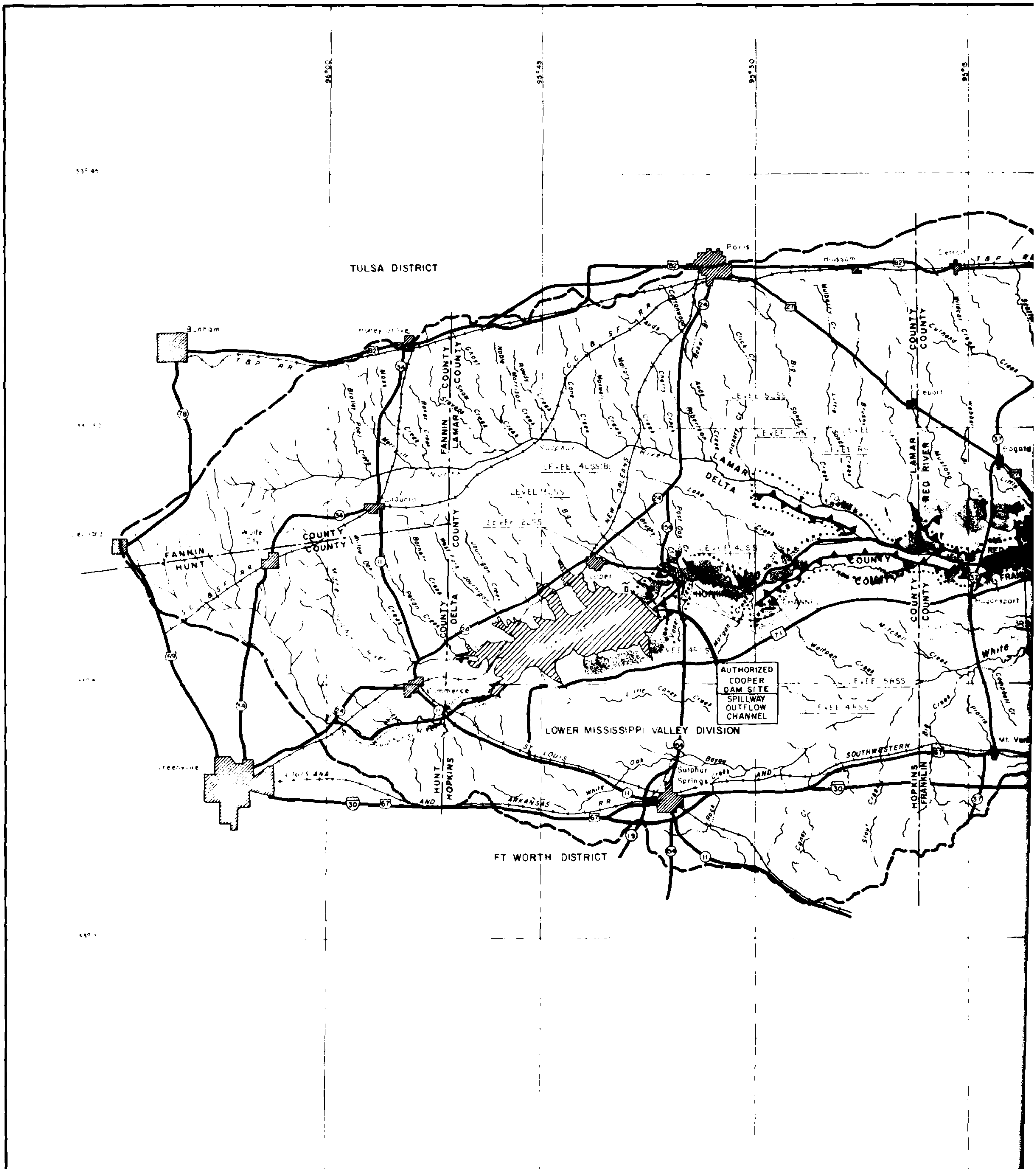
PLATE VI-5


TULSA DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
AUTHORIZED COOPER DAM SITE
SPILLWAY OUTFLOW CHANNEL
LEVEE 5LSS
LEVEE 1RN
LEVEE 1LS
LEVEE RS
LEVEE 4.5S(B)
LEVEE 3LSS
LEVEE 2LSS
LEVEE 5RSS
LEVEE 4RSS
Paris
Blossom
Detroit
Honey Grove
Bonham
Ladonia
Cooper
Commerce
Sulphur Springs
Deport
FANNIN
HUNT
COUNTY
COUNTY
FANNIN COUNTY
LAMAR COUNTY
DELTA COUNTY
HUNT
HOPKINS
HOPKINS
FRANKLIN
LAMAR
DELTA
SOUTHWESTERN
ARKANSAS



OKLAHOMA
LOCATION OF WORK
NEW MEXICO
ARK.
LA.
TEXAS
MEXICO
GULF OF MEXICO
El Paso
San Angelo
Fort Worth
Dallas
Austin
Houston
Galveston
Freeport
Brownsville
VICINITY MAP
SCALE OF MILES
Detroit
Bagwell
Clarksville
Deport
Bogota
Hagansport
Mt. Vernon
Mount Pleasant
De Kalb
New Boston
Naples
Caney Creek Reservoir
Elliott Creek Reservoir
WRIGHT PATMAN LAKE
LAMAR COUNTY
RED RIVER COUNTY
BOWIE COUNTY
CASS COUNTY
MORRIS
TITUS
FRANKLIN
HOPKINS
Oak
Bayou
White
Oak
LEVEE 3RS(B)
LEVEE 5RSS
SOUTHWESTERN
LEGEND
INTERSTATE HWY
STATE HWY
FEDERAL HWY
EXISTING LEVEE
EXISTING CHANNEL
RAILROAD
WATERSHED BOUNDARY
30 YEAR STATUS QUO FLOOD LIMIT
WOODED AREA
Scale in Miles
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
RESERVOIR AND LEVEE ALINEMENT WITH CLEARING AND SNAGGING OF RIVER
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1977
FILE NO. H-2-26659

PLATE VI-



TULSA DISTRICT
Paris
Blossom
Bonham
Honey Grove
FANNIN
HUNT
COUNTY
LAMAR
DELTA
RED RIVER
HOPKINS
FRANKLIN
NEW ORLEANS
AUTHORIZED
COOPER
DAM SITE
SPILLWAY
OUTFLOW
CHANNEL
LOWER MISSISSIPPI VALLEY DIVISION
Sulphur
Springs
SOUTHWESTERN
ST LOUIS
ARKANSAS
AND
FT WORTH DISTRICT

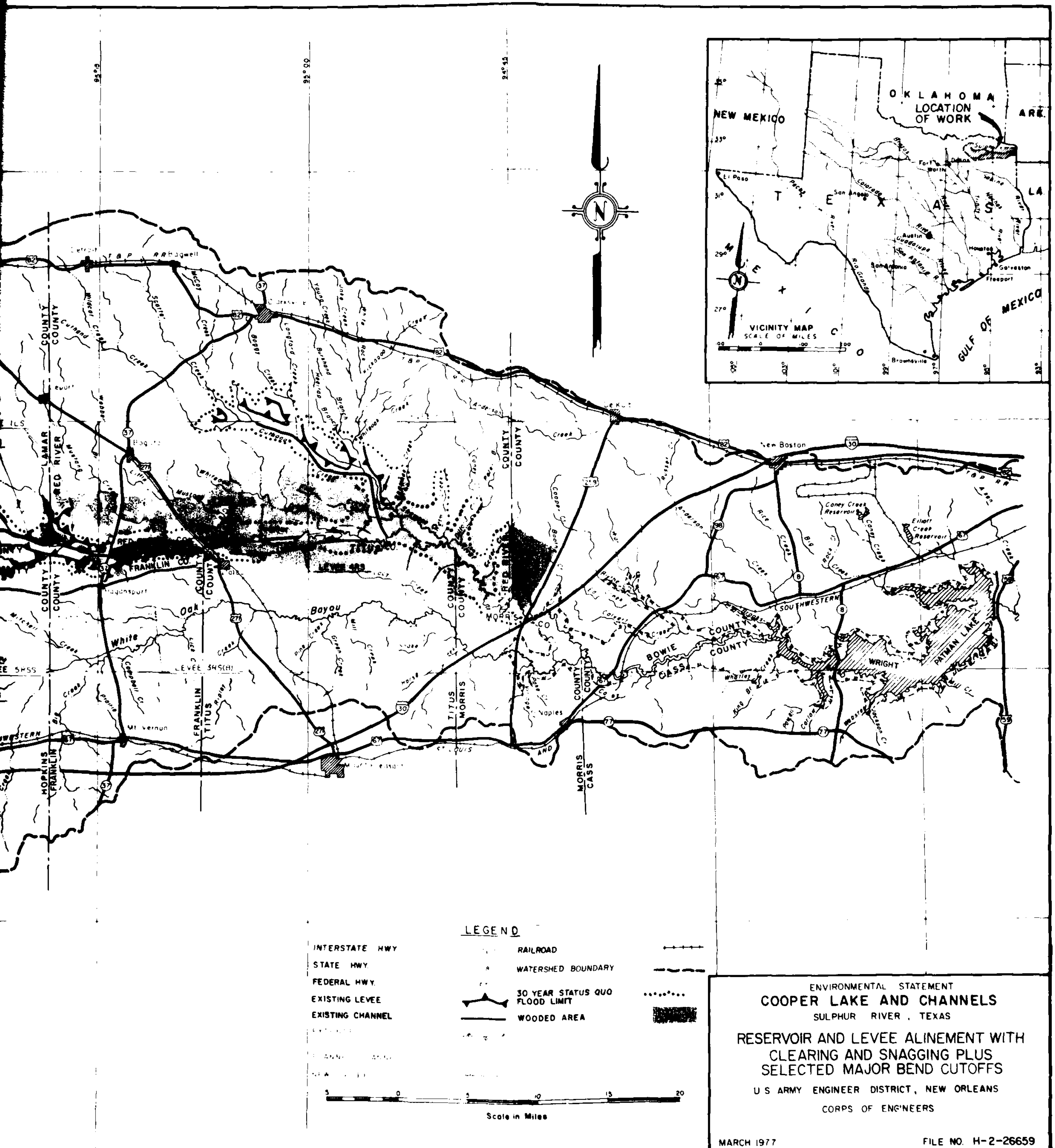
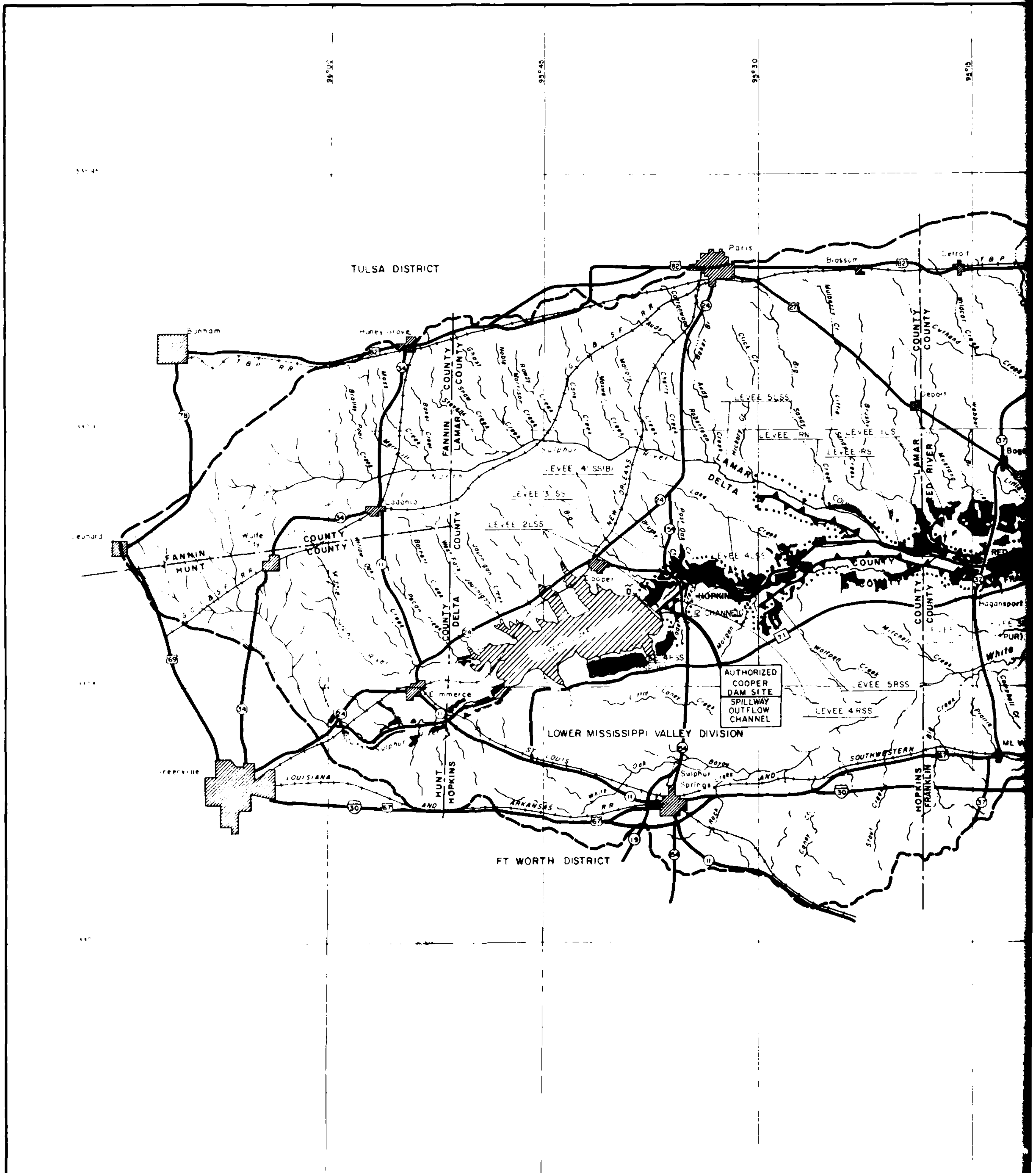
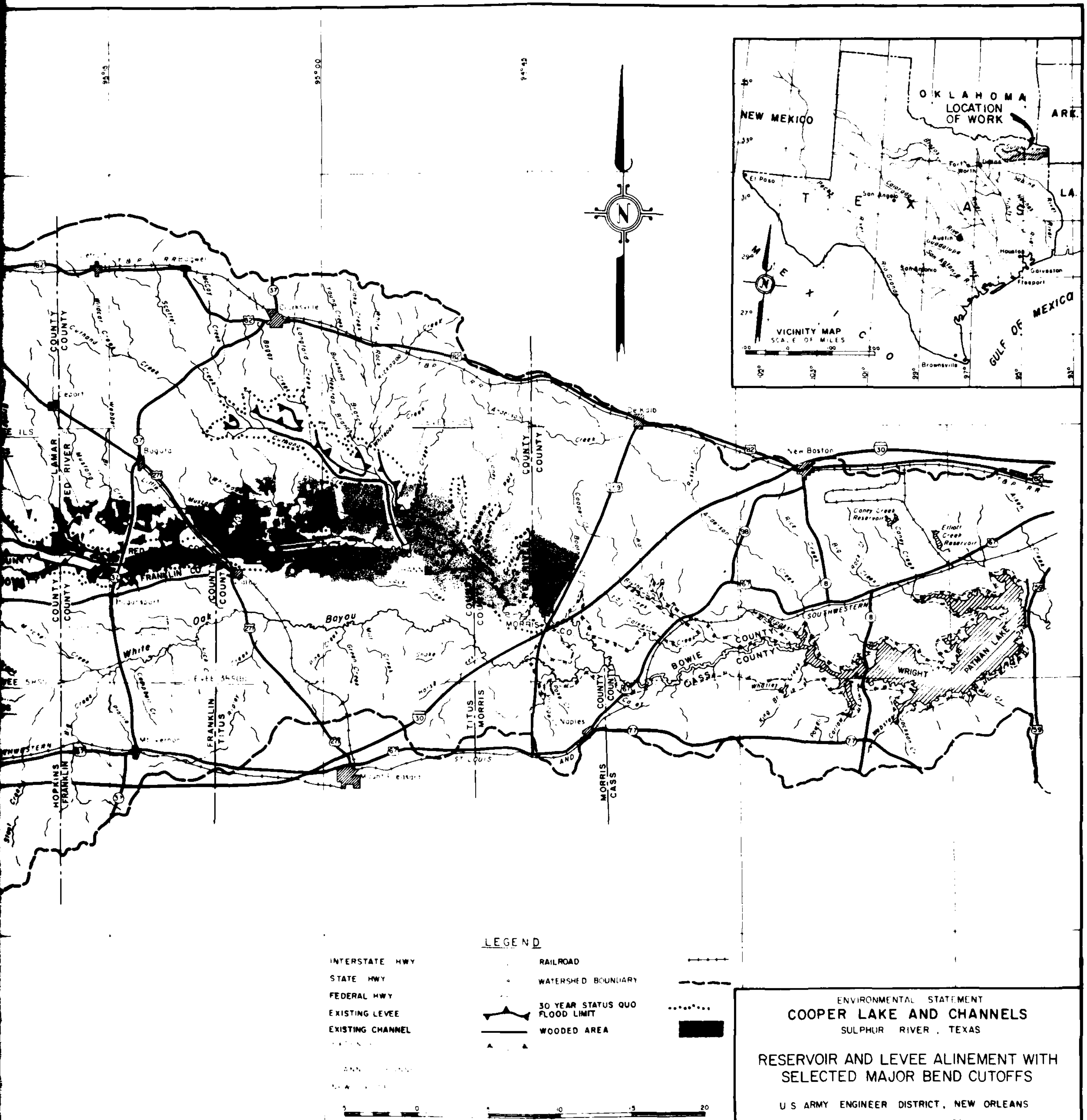

OKLAHOMA
LOCATION OF WORK
NEW MEXICO
ARK.
LA.
T E X A S
GULF OF MEXICO
VICINITY MAP
SCALE OF MILES
LEGEND
INTERSTATE HWY
STATE HWY
FEDERAL HWY
EXISTING LEVEE
EXISTING CHANNEL
RAILROAD
WATERSHED BOUNDARY
30 YEAR STATUS QUO FLOOD LIMIT
WOODED AREA
Scale in Miles
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
RESERVOIR AND LEVEE ALINEMENT WITH CLEARING AND SNAGGING PLUS SELECTED MAJOR BEND CUTOFFS
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1977
FILE NO. H-2-26659

PLATE VI-7



TULSA DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
AUTHORIZED COOPER DAM SITE
SPILLWAY OUTFLOW CHANNEL
Paris
Bonham
Honey Grove
Ladonia
Wolfe City
Cooper
Commerce
Sulphur Springs
Blossom
Detroit
Deport
Hagansport
FANNIN COUNTY
HUNT COUNTY
LAMAR COUNTY
DELTA COUNTY
HOPKINS COUNTY
RED RIVER COUNTY
FRANKLIN COUNTY
LEVEE 5LSS
LEVEE 4LSS(B)
LEVEE 3LSS
LEVEE 2LSS
LEVEE 4LSS
LEVEE RN
LEVEE 1LS
LEVEE RS
LEVEE 5RSS
LEVEE 4RSS
4RSS
CHANNEL
Sulphur
Cuthand Creek
Mitchell Creek
White Oak Creek
Cypress
Big Sandy
Hickory
Pecan Creek
Jernigan Creek
Wolfpen Creek
Little Creek
Caney Creek
Stout Creek
Rock Creek
Cane Creek
Mustang Creek
Bachelor
Morrison
Noble
Lake Creek
Merrill Creek
Brushy
Campbell Cr
GC & SF RR
NEW ORLEANS
ST LOUIS
SOUTHWESTERN
LOUISIANA AND ARKANSAS RR
T & P RR
96°00
95°45
95°30
95°15



ENVIRONMENTAL STATEMENT

COOPER LAKE AND CHANNELS

SULPHUR RIVER, TEXAS

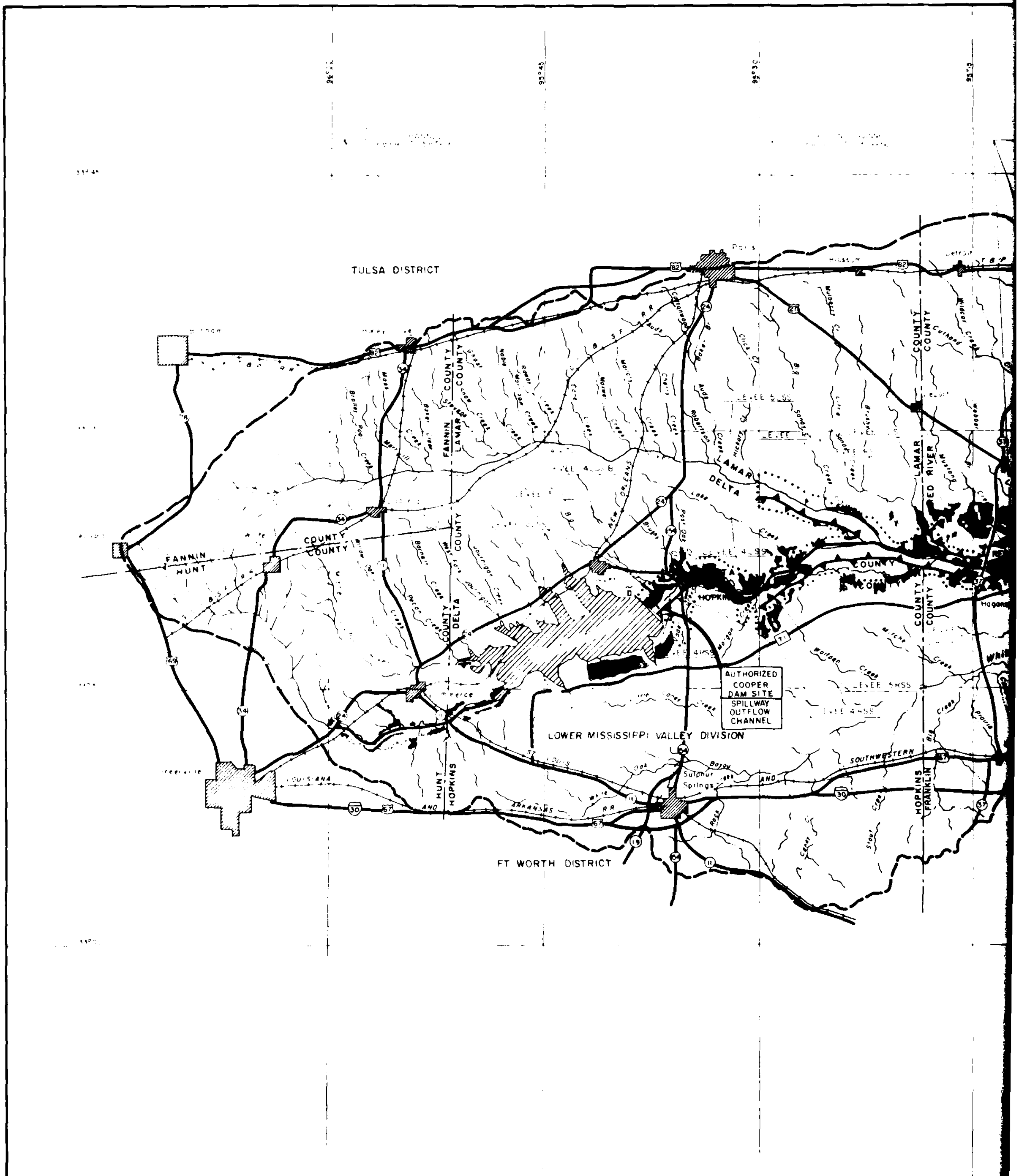
RESERVOIR AND LEVEE ALINEMENT WITH SELECTED MAJOR BEND CUTOFFS

U S ARMY ENGINEER DISTRICT, NEW ORLEANS

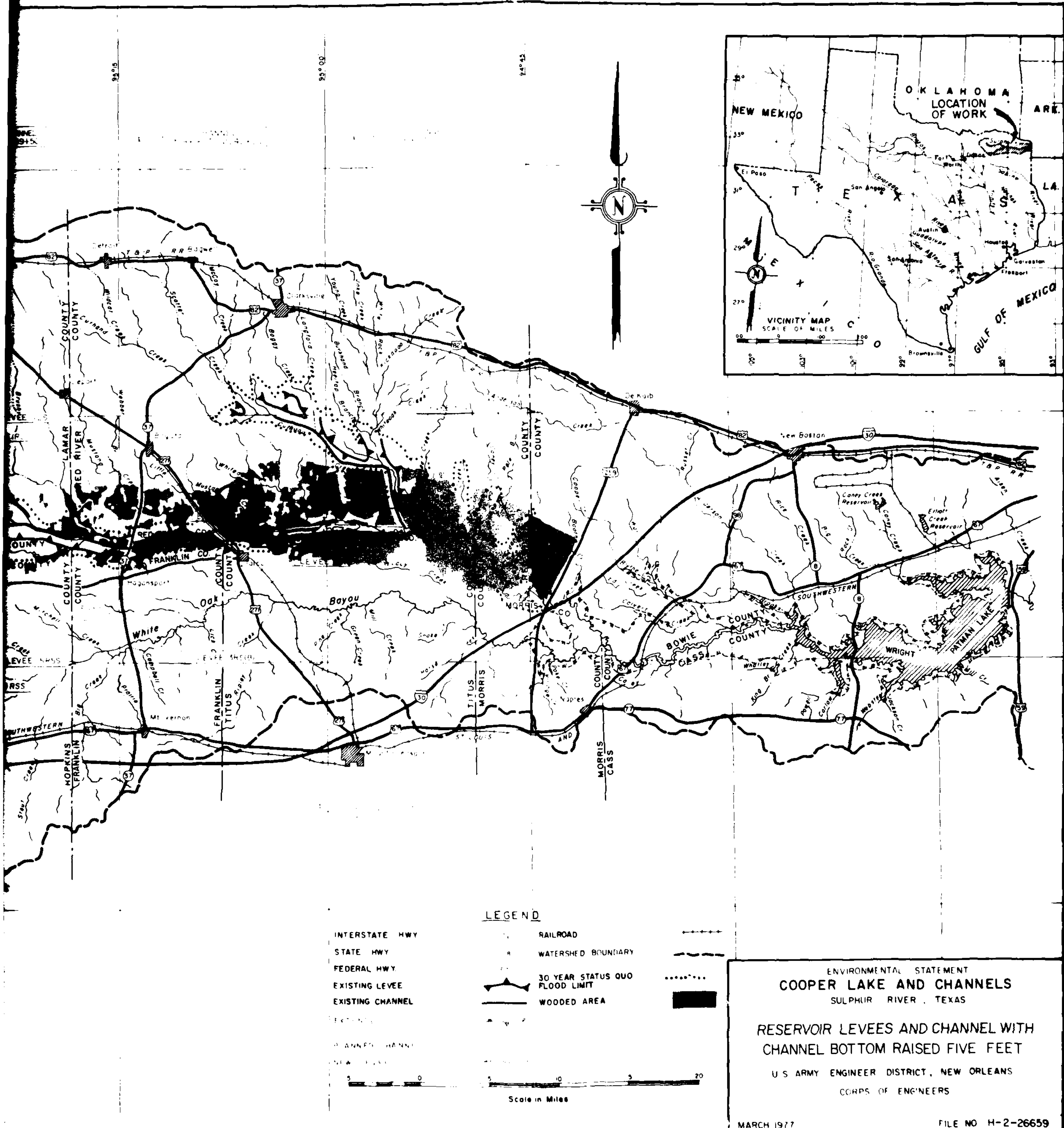
CORPS OF ENGINEERS

MARCH 1977 FILE NO. H-2-26659

PLATE VI-8



TULSA DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
AUTHORIZED COOPER DAM SITE
SPILLWAY OUTFLOW CHANNEL
FANNIN COUNTY
HUNT COUNTY
LAMAR COUNTY
DELTA COUNTY
HOPKINS COUNTY
RED RIVER COUNTY
FRANKLIN COUNTY
Paris
Sulphur Springs
LAMAR
DELTA
NEW ORLEANS
LOUISIANA AND ARKANSAS R.R.
ST LOUIS SOUTHWESTERN



ENVIRONMENTAL STATEMENT

COOPER LAKE AND CHANNELS

SULPHUR RIVER, TEXAS

RESERVOIR LEVEES AND CHANNEL WITH CHANNEL BOTTOM RAISED FIVE FEET

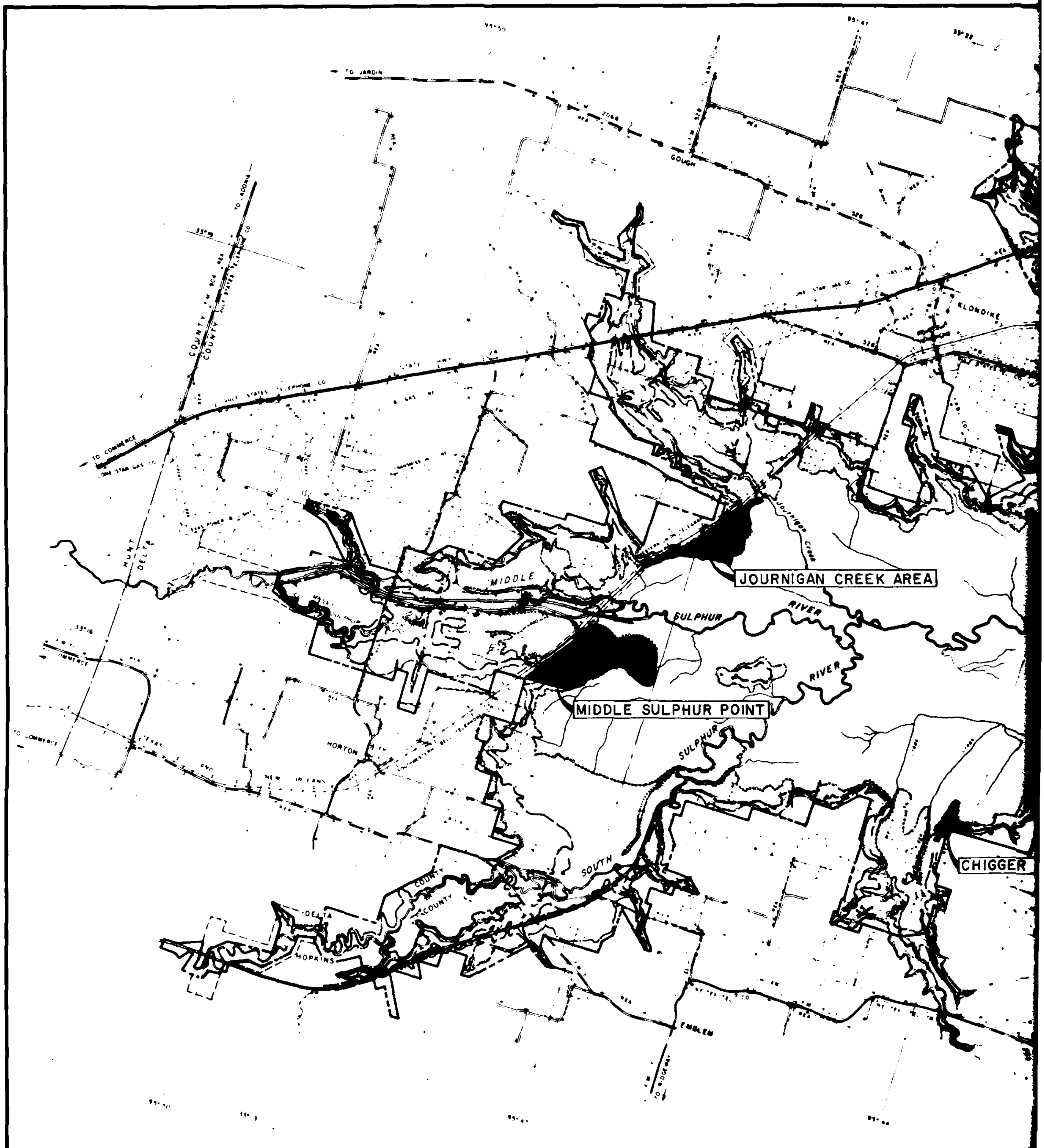
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

CORPS OF ENGINEERS

MARCH 1977

FILE NO H-2-26659

PLATE VI-



TO JARDIN
GOUGH
KLONDIKE
TO COMMERCE
TO LADONIA
MIDDLE
SULPHUR
RIVER
JOURNIGAN CREEK AREA
MIDDLE SULPHUR POINT
HORTON
SULPHUR
SOUTH
CHIGGER
DELTA
HOPKINS
COUNTY
EMBLEM

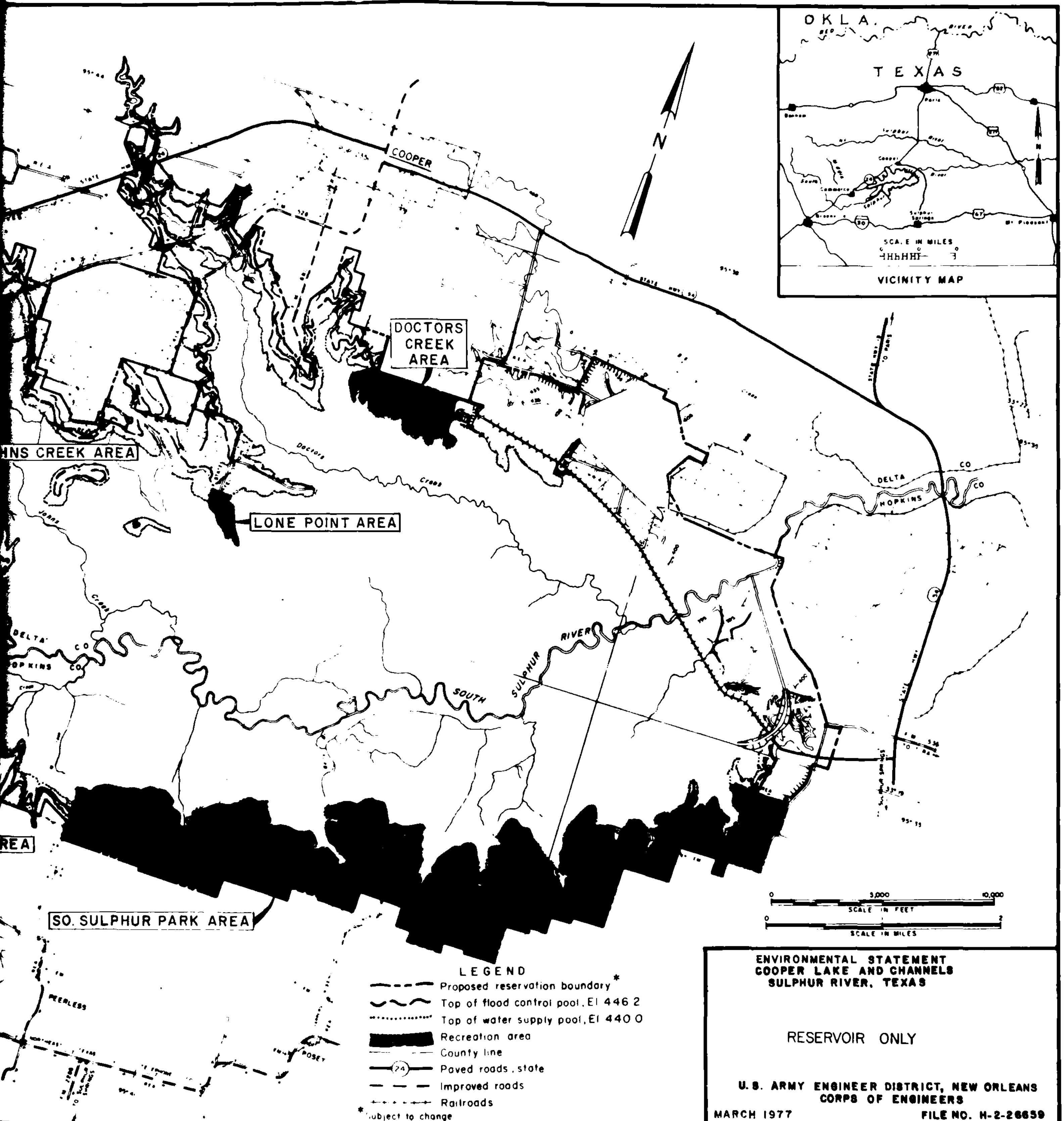
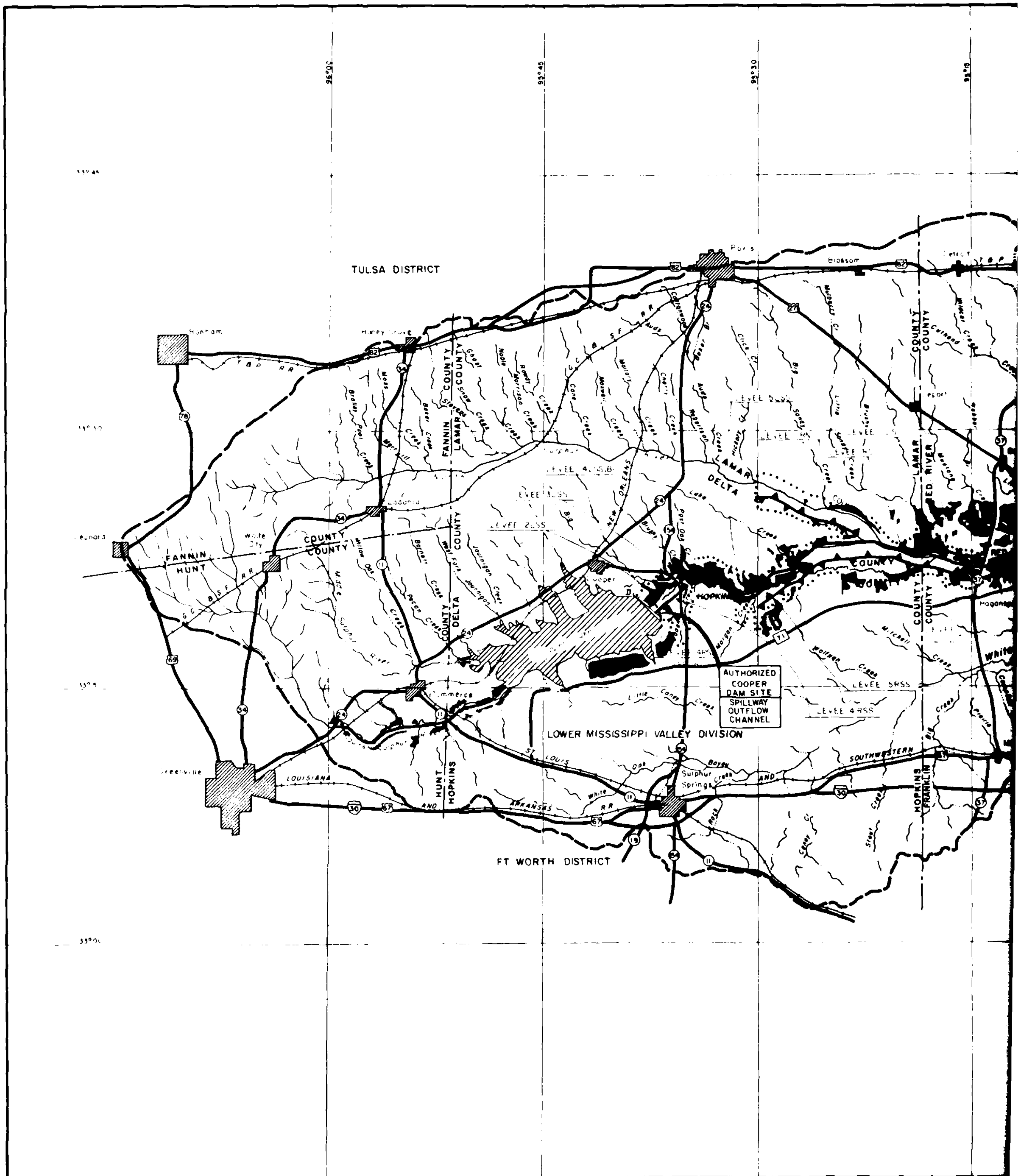

OKLA.
TEXAS
VICINITY MAP
SCALE IN MILES
N
COOPER
DOCTORS CREEK AREA
HNS CREEK AREA
LONE POINT AREA
Doctors Creek
STATE HWY. 24
DELTA CO
HOPKINS CO
SOUTH SULPHUR RIVER
REA
SO. SULPHUR PARK AREA
PEERLESS
0 5,000 10,000
SCALE IN FEET
0 2
SCALE IN MILES
LEGEND
Proposed reservation boundary*
Top of flood control pool, El 446 2
Top of water supply pool, El 440 0
Recreation area
County line
Paved roads, state
Improved roads
Railroads
*Subject to change
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
RESERVOIR ONLY
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1977
FILE NO. H-2-26659

PLATE VI-10


TULSA DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
AUTHORIZED COOPER DAM SITE
SPILLWAY OUTFLOW CHANNEL
Paris
Blossom
Honey Grove
Ladonia
Commerce
Greenville
Sulphur Springs
FANNIN
HUNT
LAMAR
DELTA
HOPKINS
RED RIVER
FRANKLIN
LEVEE 5RSS
LEVEE 4RSS
LEVEE 2LSS
LOUISIANA AND ARKANSAS
ST LOUIS SOUTHWESTERN

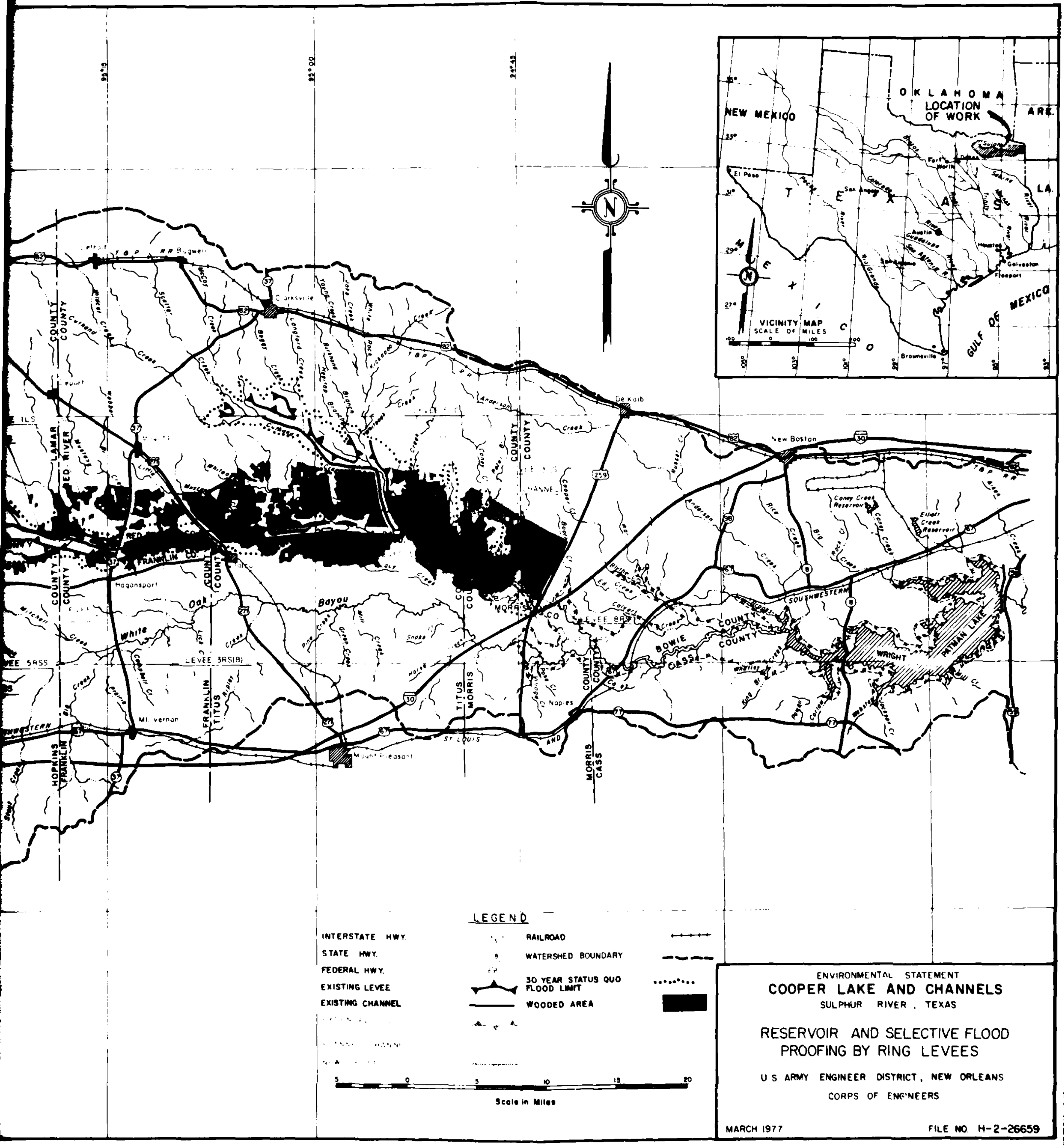
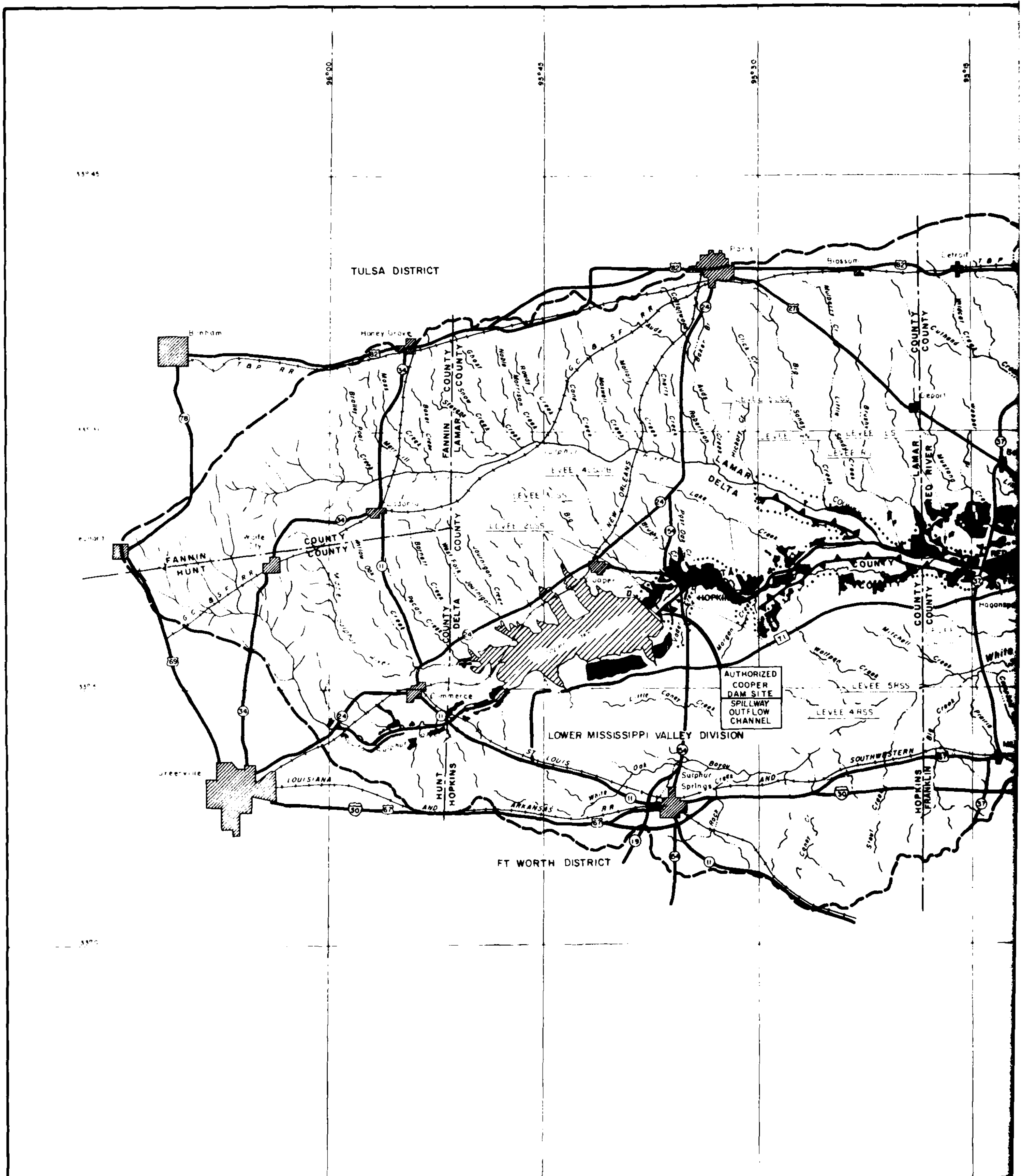
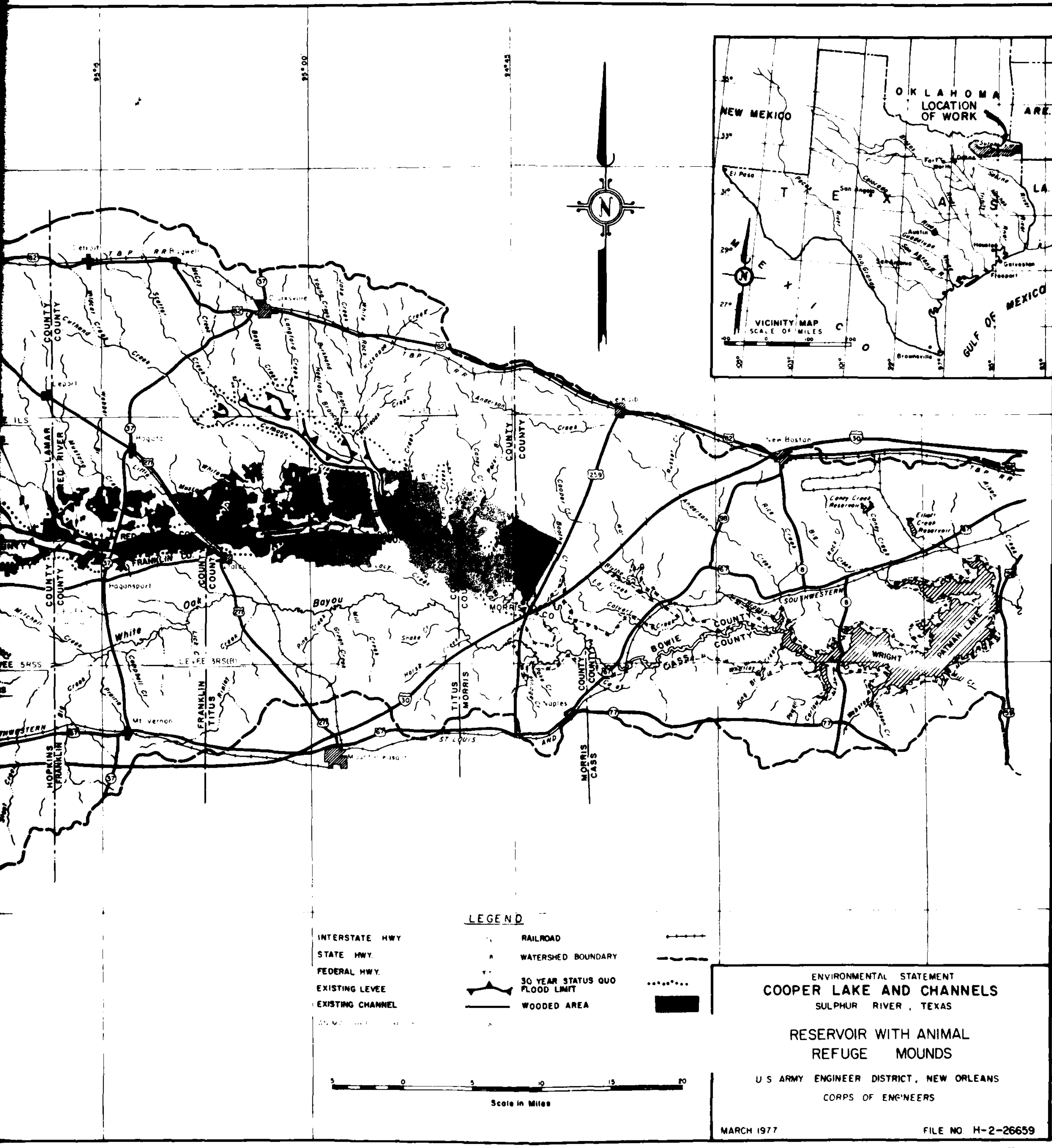

ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
RESERVOIR AND SELECTIVE FLOOD PROOFING BY RING LEVEES
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1977
FILE NO. H-2-26659
LEGEND
INTERSTATE HWY
STATE HWY.
FEDERAL HWY.
EXISTING LEVEE
EXISTING CHANNEL
RAILROAD
WATERSHED BOUNDARY
30 YEAR STATUS QUO FLOOD LIMIT
WOODED AREA
Scale in Miles
VICINITY MAP
SCALE OF MILES
OKLAHOMA
LOCATION OF WORK
NEW MEXICO
TEXAS
MEXICO
GULF OF MEXICO
ARK.
LA.
De Kalb
New Boston
Mount Pleasant
Mt. Vernon
Naples
Hagansport
Clarksville
WRIGHT PATMAN LAKE
BOWIE COUNTY
CASS COUNTY
MORRIS
TITUS
FRANKLIN
HOPKINS
LAMAR COUNTY
RED RIVER COUNTY
Coney Creek Reservoir
White Oak Bayou

PLATE VI-II



95°30
95°45
95°15
TULSA DISTRICT
Paris
Blossom
Detroit
Bonham
Honey Grove
Ladonia
Cooper
Commerce
Greenville
Sulphur Springs
Deport
FANNIN
HUNT
COUNTY
LAMAR
DELTA
HOPKINS
RED RIVER
FRANKLIN
AUTHORIZED COOPER DAM SITE
SPILLWAY OUTFLOW CHANNEL
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
LEVEE 5RSS
LEVEE 4RSS
LOUISIANA
AND
ARKANSAS
ST LOUIS
SOUTHWESTERN
NEW ORLEANS
T&P RR

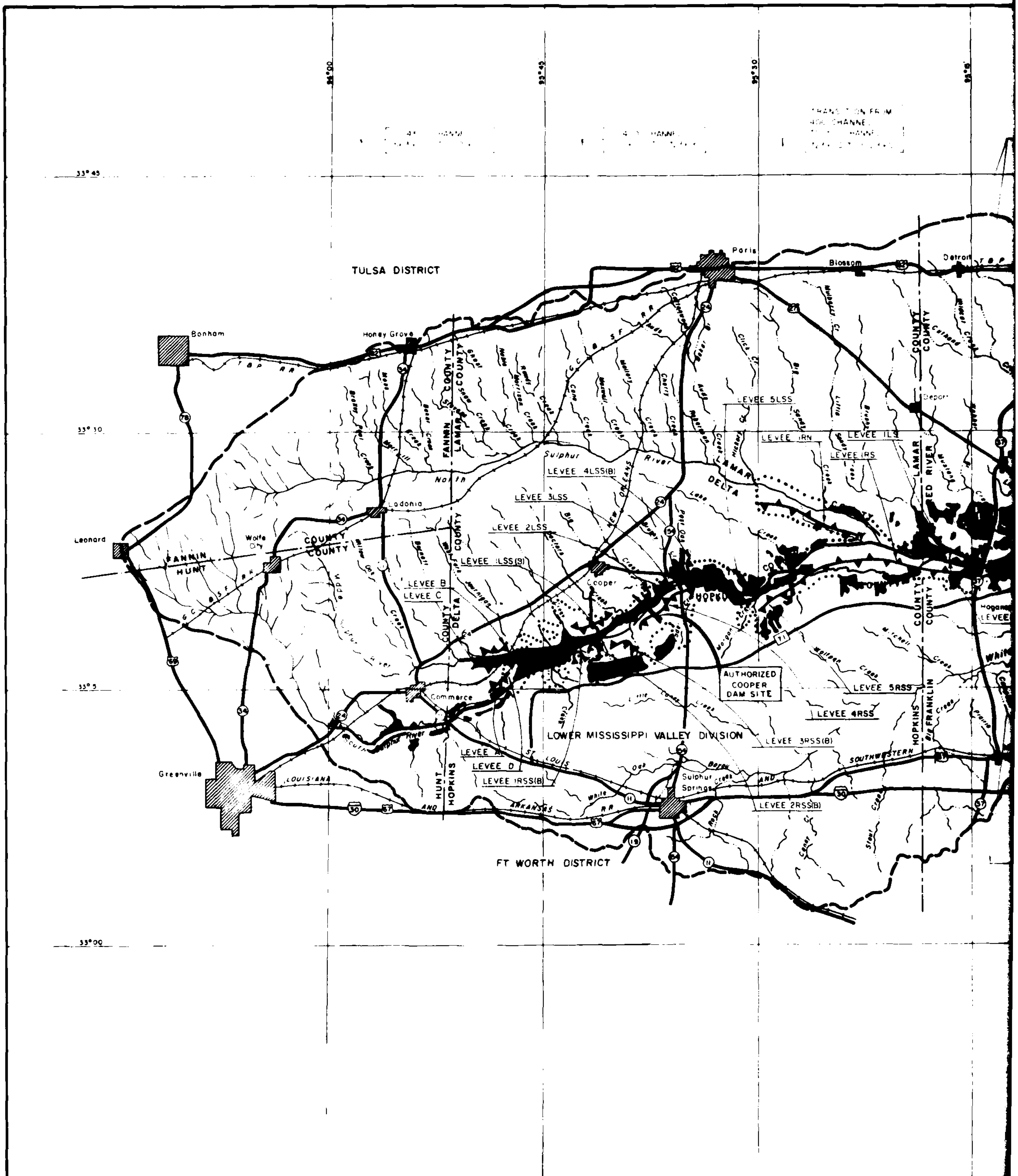


ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS

RESERVOIR WITH ANIMAL REFUGE MOUNDS

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

MARCH 1977 FILE NO. H-2-26659



33°45
33°30
33°15
33°00
TULSA DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
Bonham
Honey Grove
Paris
Blossom
Detroit
Deport
Ladonia
Leonard
Wolfe City
Cooper
Commerce
Greenville
Sulphur Springs
FANNIN COUNTY
LAMAR COUNTY
DELTA COUNTY
HUNT COUNTY
HOPKINS COUNTY
RED RIVER COUNTY
FRANKLIN COUNTY
Sulphur River
North
South Sulphur River
White Oak Creek
LEVEE 5LSS
LEVEE 1RN
LEVEE 1LS
LEVEE 1RS
LEVEE 4LSS(B)
LEVEE 3LSS
LEVEE 2LSS
LEVEE 1LSS(9)
LEVEE B
LEVEE C
LEVEE A
LEVEE D
LEVEE 1RSS(B)
LEVEE 2RSS(B)
LEVEE 3RSS(B)
LEVEE 4RSS
LEVEE 5RSS
AUTHORIZED COOPER DAM SITE
LOUISIANA
ARKANSAS
SOUTHWESTERN
ST LOUIS
T&P RR
G C & S F RR

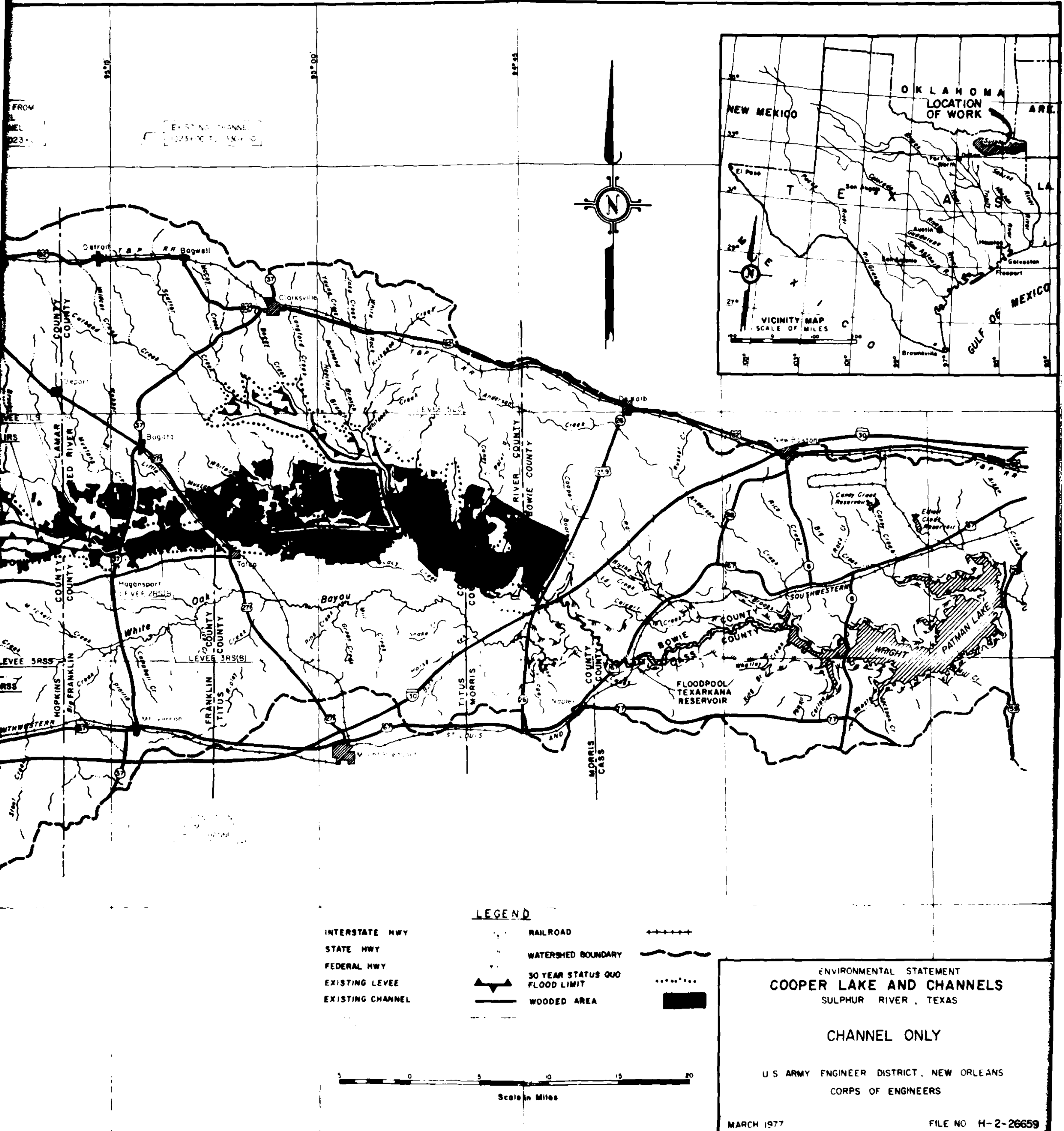
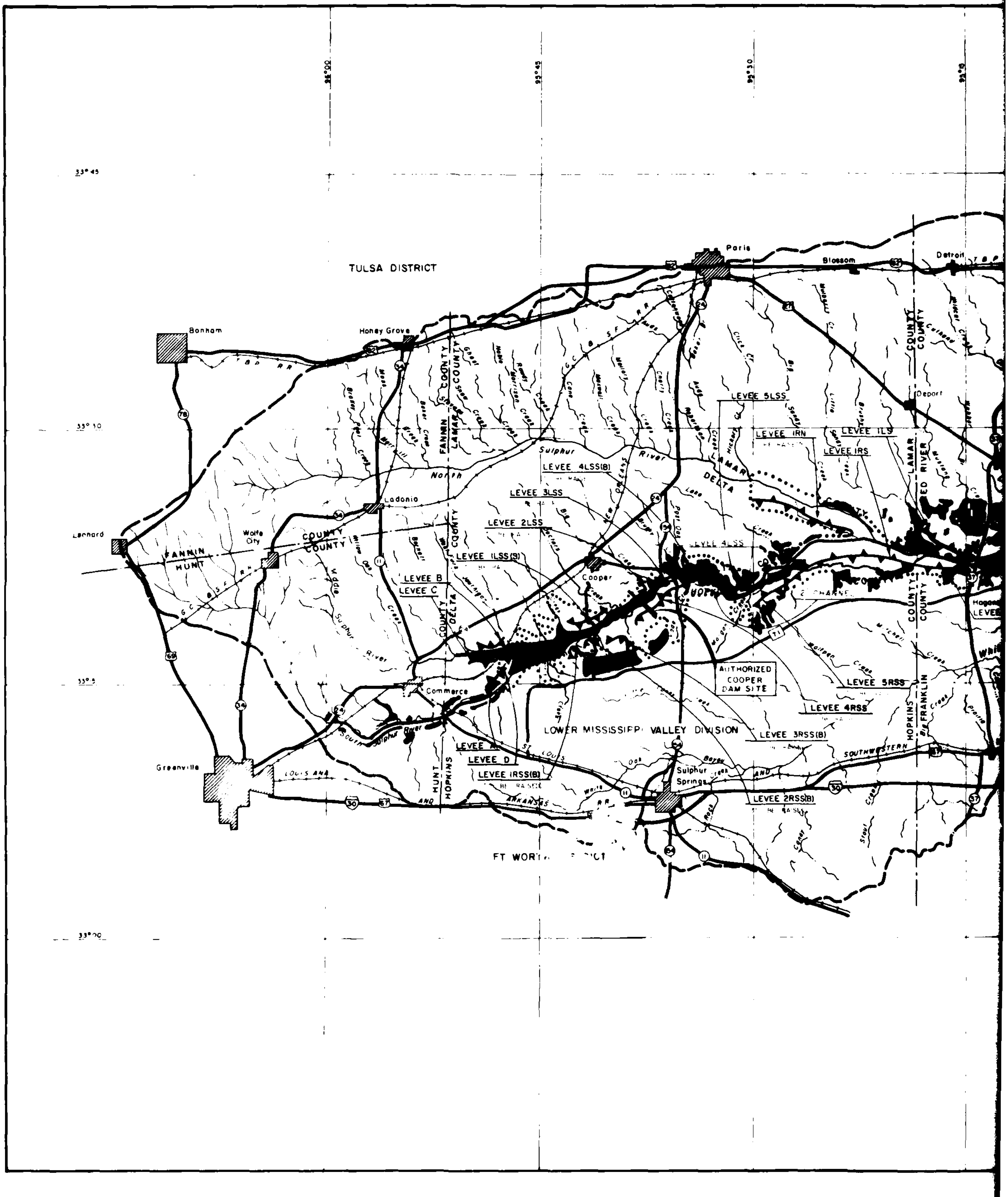

OKLAHOMA
LOCATION OF WORK
NEW MEXICO
TEXAS
GULF OF MEXICO
VICINITY MAP
SCALE OF MILES
Clarksville
Detroit
Bagwell
Deport
Bogata
Talco
Hagansport
De Kalb
New Boston
WRIGHT PATMAN LAKE
FLOODPOOL TEXARKANA RESERVOIR
Mt. Vernon
Mt. Pleasant
LEGEND
INTERSTATE HWY
STATE HWY
FEDERAL HWY
EXISTING LEVEE
EXISTING CHANNEL
RAILROAD
WATERSHED BOUNDARY
30 YEAR STATUS QUO FLOOD LIMIT
WOODED AREA
Scale in Miles
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
CHANNEL ONLY
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1977
FILE NO H-2-26659

PLATE VI



TULSA DISTRICT
Paris
Blossom
Detroit
Bonham
Honey Grove
Deport
LEVEE 5LSS
LEVEE 1RN
LEVEE 1LS
LEVEE 1RS
LEVEE 4LSS(B)
LEVEE 3LSS
LEVEE 2LSS
LEVEE 1LSS(3)
LEVEE 4LSS
LEVEE B
LEVEE C
Ladonia
Leonard
Wolfe City
FANNIN
HUNT
COUNTY
Cooper
AUTHORIZED COOPER DAM SITE
LEVEE 5RSS
LEVEE 4RSS
LEVEE 3RSS(B)
LEVEE 2RSS(B)
LEVEE A
LEVEE D
LEVEE 1RSS(B)
Commerce
LOWER MISSISSIPPI VALLEY DIVISION
Greenville
Sulphur Springs
HUNT
HOPKINS
DELTA
LAMAR
FRANKLIN
North Sulphur River
South Sulphur River
Middle Sulphur River
FT WORTH DISTRICT

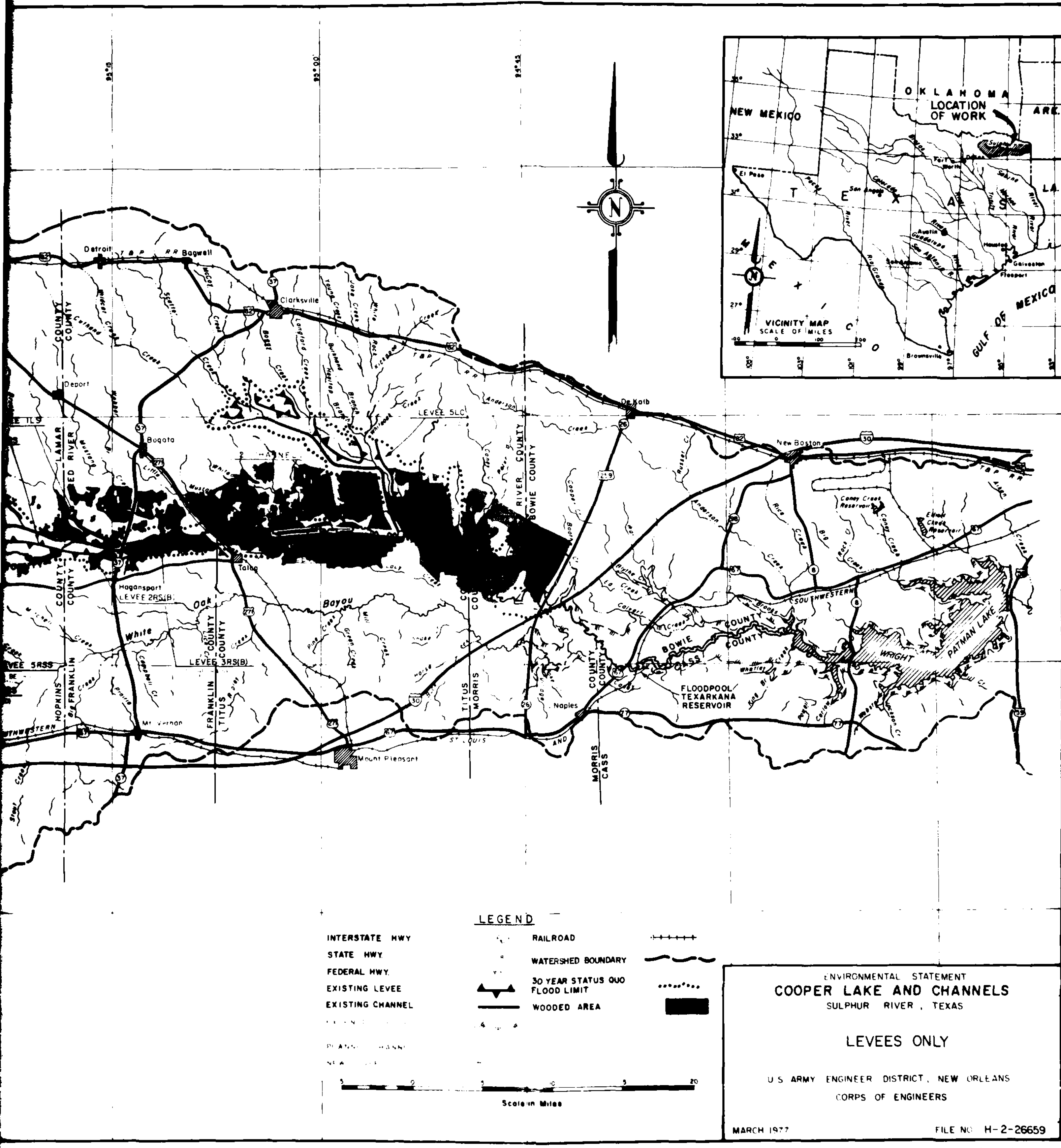
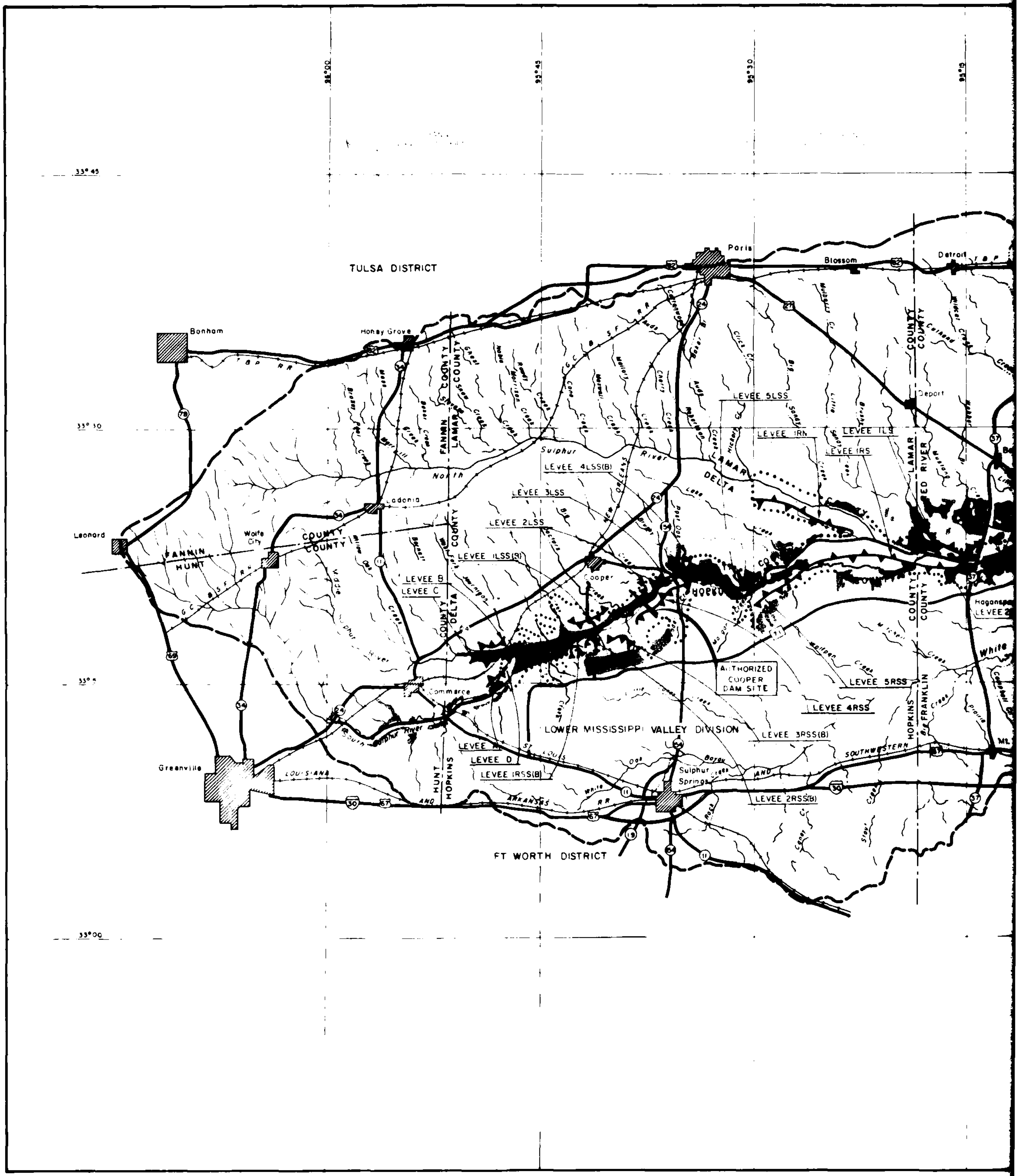
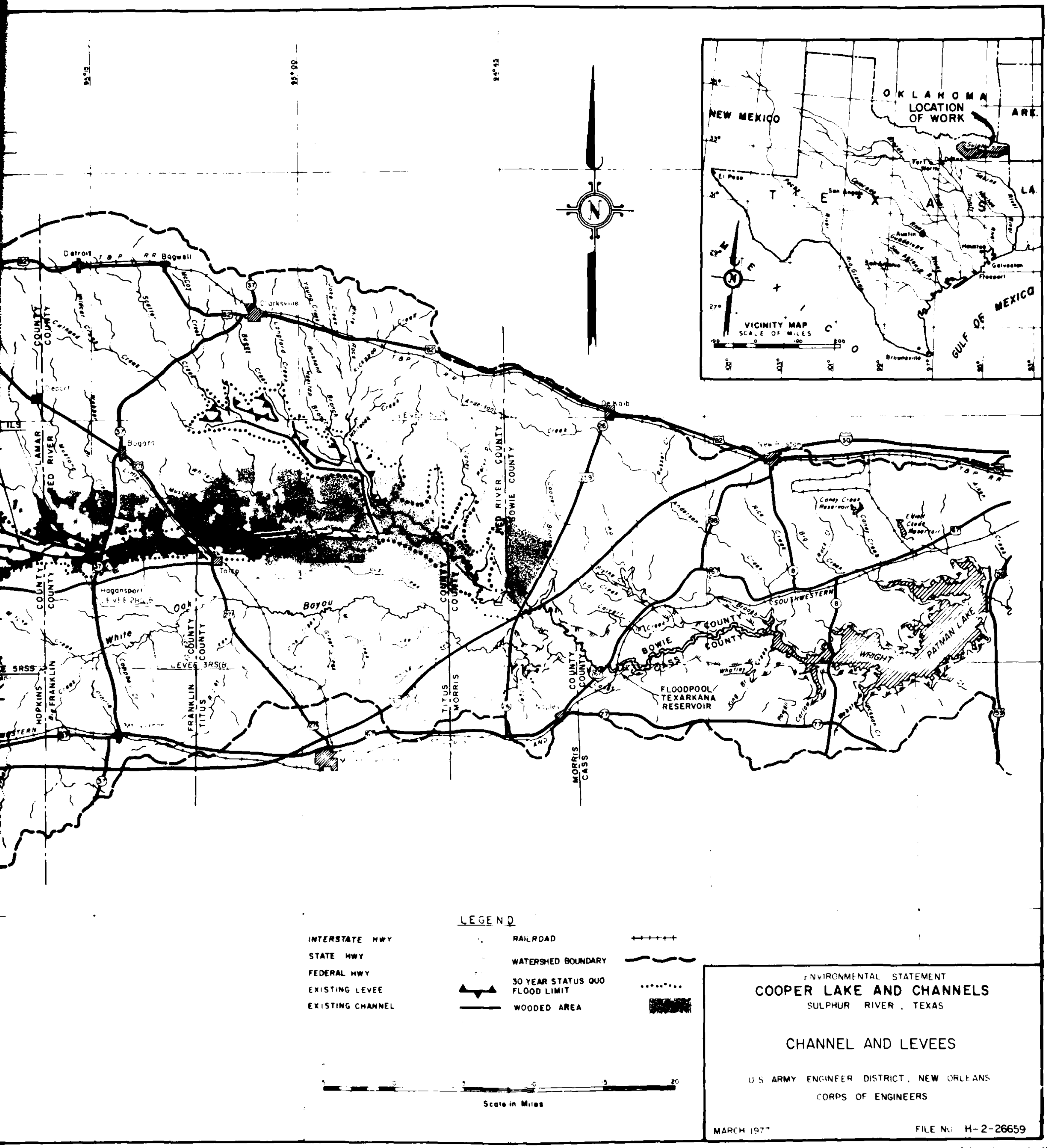

OKLAHOMA
LOCATION OF WORK
NEW MEXICO
ARK.
LA.
TEXAS
MEXICO
GULF OF MEXICO
VICINITY MAP
SCALE OF MILES
Clarksville
Detroit
Bagwell
Deport
Bogata
Talco
Hagansport
Mt. Vernon
Mount Pleasant
Naples
De Kalb
New Boston
LEVEE 5LC
LEVEE 2RS(B)
LEVEE 3RS(B)
LEVEE 5RSS
White Oak Bayou
FLOODPOOL TEXARKANA RESERVOIR
WRIGHT PATMAN LAKE
LEGEND
INTERSTATE HWY
STATE HWY
FEDERAL HWY
EXISTING LEVEE
EXISTING CHANNEL
RAILROAD
WATERSHED BOUNDARY
30 YEAR STATUS QUO FLOOD LIMIT
WOODED AREA
Scale in Miles
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
LEVEES ONLY
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1977
FILE NO. H-2-26659

PLATE VI-



TULSA DISTRICT
FT WORTH DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION
AUTHORIZED COOPER DAM SITE
Bonham
Honey Grove
Paris
Blossom
Detroit
Deport
Ladonia
Leonard
Wolfe City
Cooper
Commerce
Greenville
Sulphur Springs
LEVEE 5LSS
LEVEE 1RN
LEVEE 1LS
LEVEE 1RS
LEVEE 4LSS(B)
LEVEE 3LSS
LEVEE 2LSS
LEVEE 1LSS(B)
LEVEE B
LEVEE C
LEVEE 5RSS
LEVEE 4RSS
LEVEE 3RSS(B)
LEVEE 2RSS(B)
LEVEE A
LEVEE D
LEVEE 1RSS(B)
FANNIN COUNTY
HUNT COUNTY
LAMAR COUNTY
DELTA COUNTY
HOPKINS
FRANKLIN
RED RIVER COUNTY
Sulphur River
North
South Sulphur River
33°45
33°30
33°15
33°00



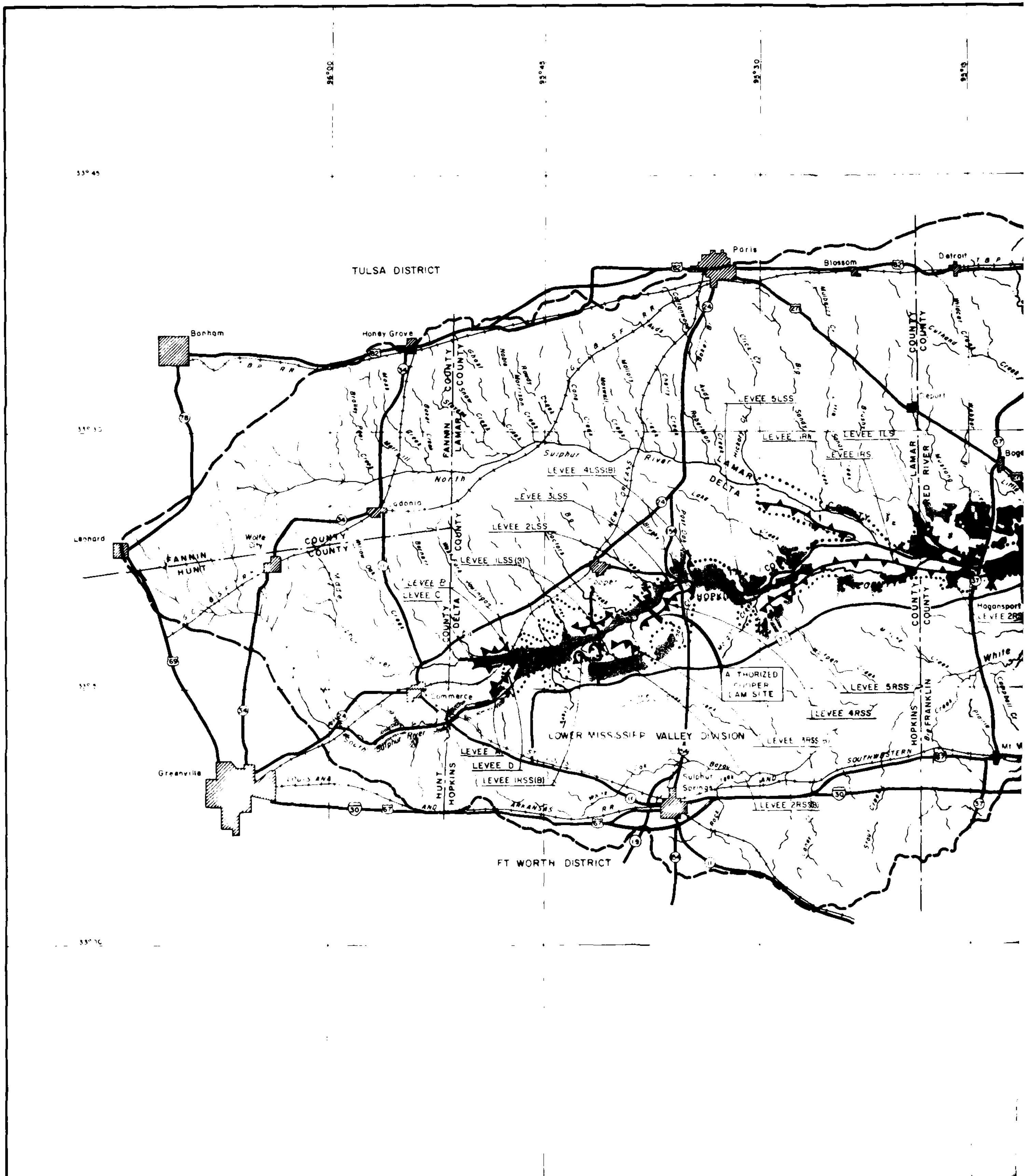
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS

CHANNEL AND LEVEES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

MARCH 1977 FILE NO. H-2-26659

PLATE VI-15


TULSA DISTRICT
Paris
Blossom
Detroit
Bonham
Honey Grove
Ladonia
Lennard
Wolfe City
Commerce
Greenville
Sulphur Springs
Cooper
Deport
Hagansport
Mt Vernon
FANNIN COUNTY
HUNT COUNTY
LAMAR COUNTY
DELTA COUNTY
HOPKINS COUNTY
RED RIVER COUNTY
FRANKLIN COUNTY
LEVEE 5LSS
LEVEE 1RN
LEVEE 1LS
LEVEE 1RS
LEVEE 4LSS(8)
LEVEE 3LSS
LEVEE 2LSS
LEVEE 1LSS(3)
LEVEE B
LEVEE C
LEVEE A
LEVEE D
LEVEE 1RSS(8)
LEVEE 5RSS
LEVEE 4RSS
LEVEE 3RSS
LEVEE 2RSS(8)
AUTHORIZED COOPER DAM SITE
LOWER MISSISSIPPI VALLEY DIVISION
FT WORTH DISTRICT
North Sulphur River
South Sulphur River
White Oak
33°45
33°30
33°15
33°00
96°00
95°45
95°30
95°15

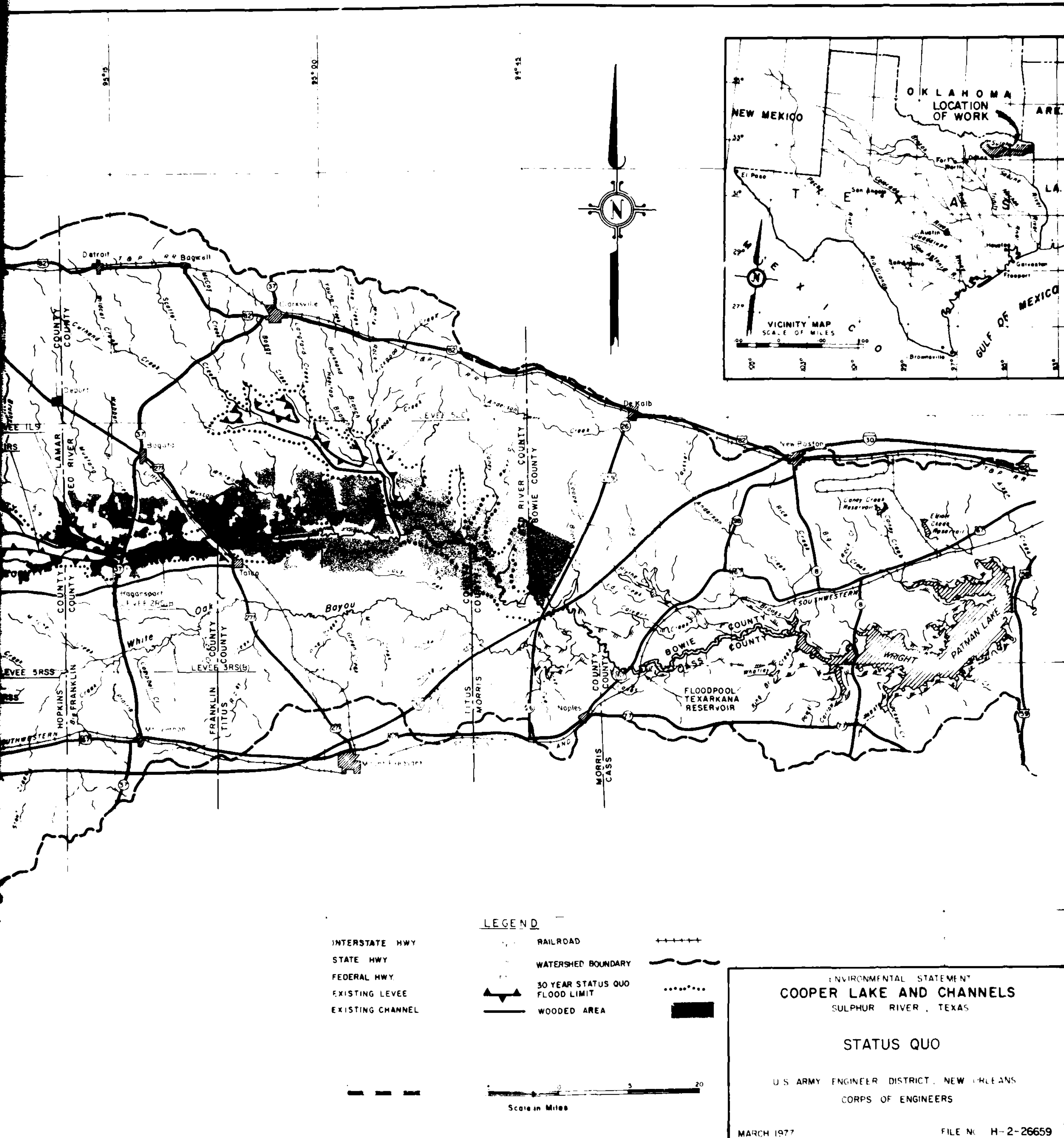

OKLAHOMA
LOCATION OF WORK
NEW MEXICO
ARK.
LA.
TEXAS
MEXICO
GULF OF MEXICO
VICINITY MAP
SCALE OF MILES
Detroit
Bagwell
Clarksville
Deport
Bogata
Talco
De Kalb
New Boston
Naples
Hagansport
LEVEE 2RS(b)
LEVEE 3RS(B)
LEVEE 5RSS
LEVEE 1LS
LAMAR COUNTY
RED RIVER COUNTY
BOWIE COUNTY
HOPKINS
FRANKLIN COUNTY
TITUS COUNTY
MORRIS
CASS COUNTY
White Oak Bayou
FLOODPOOL TEXARKANA RESERVOIR
WRIGHT PATMAN LAKE
LEGEND
INTERSTATE HWY
STATE HWY
FEDERAL HWY
EXISTING LEVEE
EXISTING CHANNEL
RAILROAD
WATERSHED BOUNDARY
30 YEAR STATUS QUO FLOOD LIMIT
WOODED AREA
Scale in Miles
ENVIRONMENTAL STATEMENT
COOPER LAKE AND CHANNELS
SULPHUR RIVER, TEXAS
STATUS QUO
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MARCH 1977
FILE NO. H-2-26659

PLATE VI-

APPENDIX G

WATER QUALITY TABLES

Table G-1

CHEMICAL ANALYSIS OF THE SOUTH SULPHUR RIVER NEAR COOPER, TEXAS

Extremes: Dissolved solids maximum: 1,150 mg/l November 9, 1962
Minimum: 68 mg/l June 24-25, 1961
Hardness: maximum: 347 mg/l February 1-28, 1963; minimum: 42 mg/l June 24-25, 1961.
Specific conductance: maximum daily, 2,130 micromhos November 9, 1962; minimum daily, 92 micromhos December 11, 1960.
Water temperature: maximum 36° C August 6, 1960, August 10, 1962; minimum: freezing point on January 31, 1966.

Water Year	Mean Discharge (cfs)	SiO_2 (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	K (ppm)	HCO_3 (ppm)	SO_4 (ppm)	Cl (ppm)	F (ppm)	NO_3 (ppm)	Dissolved Salts Calculated (ppm)	Hardness Ca,Mg (ppm)	Hardness Non-Carb (ppm)	Spec Conductance (Micromhos)	pH (standard units)
1960	339	12	49	5.4	31		169	35	25	0.4	21	250	144	5	410	7.2
1961	387	9.7	27	2.8	14		92	18	8.9	0.4	1.4	129	79	3	220	
1962	331	13	27	2.8	14		93	18	8.1	-	3.2	134	79	6	220	7.0
1963	156	12	32	3.2	17		103	26	12	-	3.2	159	92	8	258	6.7
1964	134	9.9	28	3.3	14		93	19	7.9	-	1.3	134	84	3	227	7.2
1965	430	9.9	54	6.4	30		189	39	21	-	1.3	111	70	2	188	6.9
1966	473	8.1	22	1.6	6.8	2.6	74	12	3.2	0.3	1.6	94	63	2	161	7.1
1967	293	7.9	42	2.0	11	3.3	130	22	6.6	0.4	0.7	159	112	6	269	7.4
1968	666	7.4	42	2.6	13	-	129	24	8.4	-	2.0	163	115	9	279	7.8

Source: East Texas State University, 1971

Note: Blanks in the data indicate no analyses for that item were made, a dash indicates the element was present but in amount too small to record, and a zero indicates that no evidence of the presence of that element was obtained.

Table G-2

SOURCES AND SIGNIFICANCE OF DISSOLVED MINERAL CONSTITUENTS AND PROPERTIES OF WATER
(Taken from East Texas State University, 1971)

Constituent or Property	Source or Cause	Significance and Range of Values in the South Sulphur River at Cooper
Silica (SiO_2)	Dissolved from practically all rocks and soils.	Forms hard scale in pipes and boilers. Carried over in stream of high pressure boilers to form deposits on blades of turbines. Range of values 0.0 - 22.0 ppm.
Calcium (Ca) and Magnesium (Mg)	Dissolved from practically all rocks and soils, but especially from limestones and dolomites. Ca and Mg are found in large quantities in some brines.	Causes most of the hardness and scale-forming properties of water; soap consuming. Range of values Ca 17 - 116 ppm, Mg 0.8 - 14 ppm.
Sodium (Na) and Potassium (K)	Dissolved from practically all rocks and soils. Found also in ancient brines, industrial brines and sewage.	Large amounts, in combination with chloride, give a salty taste. Moderate quantities have little effect on the usefulness of water for most purposes. Sodium salts may cause foaming in steam boilers and a high content may limit use of water for irrigation. Range of values Na 4.4 - 328 ppm, K 2.0 - 6.0 ppm.
Bicarbonate (HCO_3) and Carbonate (CO_3)	Action of carbon dioxide in water on carbonate rocks such as limestone and	Bicarbonate and carbonate produce alkalinity. Bicarbonates of calcium and magnesium decompose in steam boilers and hot water facilities to form scale and release corrosive carbon dioxide gas. In combination with calcium and magnesium, cause carbonate hardness. Range of values HCO_3 43 - 403 ppm.

Table G-2 (Cont'd)

Constituent or Property	Source or Cause	Significance and Range of Values in the South Sulphur River at Cooper
Sulfate (SO_4)	Dissolved from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds.	Sulfate in water containing calcium forms hard scale in steam boilers. In large amounts, sulfate in combination with other ions gives bitter taste to water. US Public Health Service (1962) drinking water standards recommend sulfate content should not exceed 250 ppm. Range of values 6.0 - 219 ppm.
Chloride (Cl)	Dissolved from rocks and soils. Present in sewage and found in large amounts in ancient and industrial brines.	In large amounts in combination with sodium, gives salty taste to drinking water. In large quantities, increases the corrosiveness of water. US Public Health Service (1962) drinking water standards recommend chloride content should not exceed 250 ppm. Range of values 1.6 - 580 ppm.
Fluoride (F)	Dissolved in small to minute quantities from most rocks and soils. Added to many waters by fluoridation of municipal supplies.	Fluoride in drinking water reduces the incidence of tooth decay when the water is consumed during the period of enamel calcification. May cause mottling of the teeth depending on concentration of fluoride, age of child, amount consumed and susceptibility of individual. Range of values 0.3 - 0.9 ppm.
Nitrate (NO_3)	Decaying organic matter, sewage, fertilizers, and nitrates in soil.	Nitrates encourage growth of algae and other organisms which produce undesirable taste and odors. US Public Health Service (1962) drinking water standards recommend a limit of 45 ppm for nitrates. Ranges of values 0.0 - 13.0 ppm.

Table G-2 (Cont'd)

Constituent or Property	Source or Cause	Significance and Range of Values in the South Sulphur River at Cooper
Dissolved solids	Chiefly mineral constituents dissolved from rocks and soils. Includes some water of crystallization.	US Public Health Service (1962) drinking water standards recommend that waters containing more than 500 ppm dissolved solids not be used if other less mineralized supplies are available. Range of values 68 - 1,160 ppm.
Hardness as ($CaCO_3$)	In most waters nearly all the hardness is due to calcium and magnesium	Consumes soap before lather forms. Deposits soap curds on bathtubs. Hard water forms scale in boilers, water heaters and pipes. Waters of hardness as much as 60 ppm are considered soft; 61-120 ppm, moderately hard; 121-180 ppm, hard; more than 180 ppm, very hard. Range of values Ca,Mg 46 - 347 ppm; non-carbonate 0.0 - 153 ppm.
Specific Conductance (micromhos at 25°C)	Mineral content of the water.	Indicates degree of mineralization. Specific conductance is a measure of the capacity of the water to conduct an electric current. Varies with concentration and degree of ionization of constituents. The increased salinity of the soil may reduce crop yield by decreasing the ability of the plants to take up water and plant nutrients. The tendency of irrigation water to cause high buildup of sslts is called the salinity hazard of the water. The specific conductance of the water is used as an index of the salinity hazard. Range of values 109 - 2,130 ppm.
pH	Acids, Acid-generating salts and free carbon dioxide lower the pH. Carbonates, bicarbonates, hydroxides, phosphates, silicates, and borates raise the pH.	A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote increasing alkalinity; values lower than 7.0 indicate increasing acidity. Corrosiveness of water generally increases with decreasing pH. Excessively alkaline waters may also attack metals. Range of values 6.1 and 9.0.

Table G-3

BIOCHEMICAL OXYGEN DEMAND (BOD), DISSOLVED OXYGEN (DO), AND PESTICIDES IN THE SOUTH SULPHUR RIVER, NEAR TALCO, TEXAS (RESULTS IN MILLIGRAMS PER LITER EXCEPT AS INDICATED)

Date	Hour	Discharge (cfs)	pH (standard units)	Temp. (^{o}C)	BOD	DO	DO (% Saturation)	DDD	DDE	DDT	Lindane	2,4-D	Silvex	2,4,5-T
1/16/68	1330	290	7.5	6	1.8	10.0	86	0	0	0.02	00	0	0	0.02
2/14/68	1630	118	7.2	8	1.4	12.0	103							
3/19/68	1345	305	7.4	17	1.1	9.1	97	0	0.01	0.04	0	0	0	0
4/17/68	1030	140	7.7	21	1.9	7.3	84	0	0	0	0	0.30	0	0
5/14/68	1620	14,500	7.9	24	2.1	7.0	84	0	0.02	0.07	0	0.28	0	0.03
6/11/68	1700	98	7.2	30	1.9	6.1	81							
7/16/68	1720	275	7.2	28	2.3	6.7	86							
8/13/68	1350	105	7.3	29	1.4	6.2	82	0	0	0	0	0	0	0
10/8/68	1310	20	7.4	20	1.5	8.0	86	0.01	0.01	0.01		0.07	0.01	0
12/10/68	1000	132	7.8	6	1.4	12.0	99							
2/3/69	1400	21,300	7.3	10	3.2	11.3	104							
4/9/69	2010	118	7.6	21	2.7	8.0	92	0	0	0	0	0.12	0	0
6/2/69	1440	136	7.5	26	2.2	6.2	76	0	0	0	0	0.13	0.01	0.03
7/8/69	1900	11	7.4	32	2.0	5.2	70	0	0	0	0	0	0	0.20
8/13/69	1545	2.2	7.6	31	1.3	6.1	81	0	0	0	0	0.07	0	0.20

Source: East Texas State University, 1971.

Note: A zero indicates that no evidence of the presence of that element was obtained.

DDD - Bowie County
FFF - Cass County
JJJ - Harrison County

Table G-4

INDUSTRIAL AND MUNICIPAL WATER USES AND DISCHARGES

Code	Plate	Name	Intake, MGD	Usage, MGD	Remarks
DDD1		International Creosoting and Construction Co.	0.04 surface	0.02 cooling 0.02 boiler 0.03 sanitary	Treatment
DDD2		USA Lone Star Ammunition Plant	1.42 municipal	0.15 cooling 0.17 boiler 0.80 sanitary 0.30 other	Treatment
DDD4		W.S. Dickey Clay Manufacturing Co. Texarkana Plant	0.028 municipal	0.02 cooling 0.001 boiler 0.007 sanitary	Treatment
FFF1		International Paper Co. Texarkana Mill	16.56 surface	1.00 boiler 15.55 process 0.01 sanitary	Treatment
JJJ1		Texaco, Inc. 039 Waskom, Texas Sales Terminal	0.0003 municipal 0.004 rain	0.0003 sanitary	Locals

Source: Information abstracted from Refuse Act Discharge Permit Applications

JJJ - Harrison County
MMM - Lamar County
OOO - Morris County
QQQ - Titus County

Table G-4 (Cont'd)

INDUSTRIAL AND MUNICIPAL WATER USES AND DISCHARGES

Code	Plate	Name	Intake, MGD		Usage, MGD		Remarks
JJJ2		Longhorn Army Ammunition Plant	0.80	surface	0.34 0.17 0.10 0.17 0.02	cooling boiler process sanitary other	Treatment
MMM1		Babcock and Wilcox Co. Paris Works	0.05 0.43	municipal surface	0.45 0.00 0.02	cooling boiler sanitary	Treatment
OOO1		Lone Star Steel Co.	95	surface	80.0 2.9 5.0 0.3	cooling boiler process sanitary	Treatment
OOO2		Air Products and Chemicals, Inc.	9.65	surface	9.65	cooling	No abatement practices
QQQ1		American Petrofina Co. of Texas	0.69 0.27	municipal ground	0.56 0.36 0.05 0.006	cooling boiler process sanitary	Treatment
QQQ2		Industrial Generating Co.	-------		-------		Treatment
RRR1		Gilmer Potteries, Inc.	0.01	municipal	0.0025 0.0030 0.0045	process sanitary other	No abatement practices listed

Table G-5

Water Samples for Selected Locations
(20-21 November 1974)

Station	COD mg/l	NH_3 mg/l	NO_3 mg/l	Turbidity JTU	PO_4 mg/l	Cl mg/l	TKN mg/l	Alk mg/l
16060	69.4	0.07	2.1	13.0	3.27	47	3.33	246.6
16090	32.1	0.18	0.8	5.3	0.79	57	0.23	241.2
16110	50.3	0	2.6	15.0	0.44	20	1.01	140.4
16120	39.1	0	1.6	15.0	0.51	16	0.59	137.0
16510	49.5	0	4.2	51.0	1.58	30	1.45	81.8
16540	34.7	0.22	3.4	30.0	1.38	12	6.50	68.8

Station	Total Solids mg/l	Fe mg/l	Pb mg/l	Zn mg/l	Cr mg/l	Ca mg/l	Cd mg/l	Ni mg/l	Hg mg/l
16060	588	0.34	<0.200	0.024	<0.050	<0.050	<0.050	<0.075	<0.00005
16090	521	0.32	<0.200	0.228	<0.050	<0.050	<0.050	<0.050	<0.00005
16110	302	0.86	<0.200	0.400	<0.050	<0.050	<0.050	<0.075	<0.00005
16120	281	0.73	<0.200	0.048	<0.050	<0.050	<0.050	<0.075	<0.00005
16510	310	2.30	<0.200	0.280	<0.050	<0.050	<0.050	<0.075	<0.00005
16540	209	1.30	<0.200	0.056	<0.050	<0.050	<0.050	<0.075	<0.00005

"0" indicates parameter not detected in sample.
Source: Corps of Engineers, NOD.

Table G-6

Wright Patman Lake
Water Data (values in mg/l)

Parameter	Station Number 1	2	3	4	5
Chloride	13	10	17	34	37
Sulfate	23	14	11	55	64
TDS	98	61	56	97	72
NH_3-N	<0.1	<0.1	<0.1	<0.1	<0.1
NO_2-N	0.01	0.01	0.01	0.01	0.01
NO_3-N	0.03	0.02	0.04	0.09	0.11
Kjel-N	0.7	0.9	0.8	0.8	0.8
O-PO_4	0.12	0.08	0.07	0.10	0.10
T-PO_4	0.24	0.23	0.29	0.32	0.35
TSS	19	21	30	55	59
FSS	13	14	23	44	49
VSS	6	7	7	11	10
TOC	11	6	7	11	11
BOD_5	2.0	2.0	2.0	2.0	1.5

Table G-7

Wright Patman Lake
Sediment Data

Parameter	Station Number 1	2	3	4	5
$T-PO_4$, mg/kg	730	1,700	1,200	3,400	2,400
COD, mg/kg	4,390	62,630	46,090	64,700	60,820
Kjel-N, mg/kg	135	1,990	1,430	2,290	1,510
Volatile Solids, %	1.0	6.4	4.6	7.3	6.7
Oil and Grease mg/kg	440	1,200	1,200	1,300	1,110
Silvex, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Aldrin, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chlordane, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
DDD, ug/kg	<0.5	<0.5	<0.5	<0.5	2.1
DDE, ug/kg	<0.5	<0.5	<0.5	<0.5	3.3
DDT, ug/kg	<0.5	<0.5	<0.5	<0.5	2.0
Diazinon, ug/kg	<0.5	<0.5	<0.5	<0.5	0
Dieldrin, ug/kg	0.1	0.1	0.1	0.1	0.4
Endrin, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor Epoxide, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Lindane, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Methoxychlor, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Methyl Parathion, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Toxaphene, ug/kg	<0.5	<0.5	<0.5	<0.5	<0.5
PCB, ug/kg	8.2	<0.5	15.0	14.0	15.0
Arsenic, mg/kg	3.8	5.4	2.4	4.0	2.8
Cadmium, mg/kg	<1	<1	<1	<1	<1
Copper, mg/kg	11	13	6	13	13
Chromium, mg/kg	6.6	14	9.6	31	32
Lead, mg/kg	7.3	22	17	20	24
Mercury, mg/kg	0.01	0.10	0.05	0.05	0.06
Manganese, mg/kg	180	570	850	1100	670
Nickel, mg/kg	18	17	12	23	25
Silver, mg/kg	<1	1.3	<1	<1	<1
Zinc, mg/kg	12	53	31	77	82

"0" indicates pesticide not detected in sample.

Table G-8

Recommended EPA Criteria
For Public Water Supply Intake

Parameter	Acceptable Concentration
Ammonia, NH_3-N	0.5 mg/1
Nitrate-N, NO_3	10 mg/1
Chloride, Cl	250 mg/1
Iron, Fe	0.3 mg/1
Lead, Pb	0.05 mg/1
Zinc, Zn	5.0 mg/1
Chromium, Cr	0.05 mg/1
Cadmium, Cd	0.01 mg/1
Mercury, Hg	0.002 mg/1
Sulfate, SO_4	250 mg/1

Table G-9

RECOMMENDED EPA REGION VI
BOTTOM SEDIMENT CRITERIA

Constituent	Maximum Allowable Value (mg/kg/dry wt.)
Arsenic	5.0
Cadmium	2.0
Chromium	100
Copper	50
Lead	50
Mercury	1.0
Nickel	50
Zinc	75
Chemical Oxygen Demand (COD)	50,000
Total Kjeldahl Nitrogen (TKN)	1,000
Total Volatile Solids	80,000

AD-A100 099 ARMY ENGINEER DISTRICT NEW ORLEANS LA F/G 13/2
COOPER LAKE AND CHANNELS, TEXAS.(U)
APR 77

UNCLASSIFIED NL

6 of 6
AD
A100099

END
DATE
FILMED
7 81
DTIC

Table G-10

Wright Patman Lake Water Quality Data

Station 1					Time 0715			Station 1					Time 1305		
Depth ft.	D.O. mg/1	D.O. % Sat.	Temp. °F	pH	Cond. umhos /cm	Alk. Phen. (mg/1)	Alk. Tot. (mg/1)	Depth ft.	D.O. mg/1	D.O. %Sat.	Temp. °F	pH	Cond. umhos /cm	Alk. Phen. (mg/1)	Alk. Tot. (mg/1)
1	11.5	98	47.5	7.7	190	0	56	1	12.4	107	48	7.9	200	0	53
5	11.5	97	47.0	7.7	190			5	12.4	106	47.5	7.9	200		
10	10.2	87	47.5	7.6	190			10	12.6	107	47.5	7.8	200		
15	10.6	89	46.5	7.6	190			15	11.8	100	47.5	7.8	200		
20	10.3	85	45.0	7.5	195			20	10.6	88	45.3	7.5	205		

Table G-10 (Cont'd)

Station 2					Time 0800			Station 3					Time 0840		
Depth ft.	D.O. mg/1	% Sat.	Temp. °F	pH	Cond. umhos /cm	Alk. Phen. (mg/1)	Alk. Tot. (mg/1)	Depth ft.	D.O. mg/1	%Sat.	Temp. °F	pH	Cond. umhos /cm	Alk. Phen. (mg/1)	Alk. Tot. (mg/1)
1	9.5	99	51.5	7.5	115	0	34	1	10.4	91	49.2	6.9	105	0	20
5	10.4	89	50	7.7	120			5	10.4	91	49.4	6.9	105		
9	10.4	90	49	7.5	125										

Table G-10 (Cont'd)

Station 5					Time 0915			Station 1					Time 1720		
Depth ft.	D.O. mg/1	D.O. % Sat.	Temp. °F	pH	Cond. umhos /cm	Alk. Phen. (mg/l)	Alk. Tot. (mg/l)	Depth ft.	D.O. mg/1	D.O. %Sat.	Temp. °F	pH	Cond. umhos /cm	Alk. Phen. (mg/l)	Alk. Tot. (mg/l)
1	10.0	98	59	7.7	310	0	78	1	12.5	109	49.0	8.2	210	0	60
5	10.0	97	57	7.6	320			5	12.4	108	49.0	8.1	210		
10	9.9	96	57	7.6	320			10	12.4	107	48.0	7.85	200		
12	9.8	94	56.5	7.6	330			15	12.2	104	47.5	7.8	195		
								20	10.6	90	47.5	7.6	195		

Table G-11

Elutriate, Surface Water, and Bottom Sediment Data

Location - Sulphur River at Highway 259 Bridge

Sample No.: 1
Lab I.D. No.: WQP 103
Record No.: WQP 103
Date: 12 March 1976
Time: 0750 hours

	Water Quality			Bottom Sediment	
		Surface Water		Sample	EPA
Source	Elutriate	Dissolved	Total	Concentration	Region VI Criteria
	(mg/1)	(mg/1)	(mg/1)	(mg/kg*)	(mg/kg*)
Cd	<0.0001	<0.0001	0.0005	<0.01	2.0
Cr	0.001	0.001	0.014	6.6	100
Cu	0.0103	0.0066	0.0084	0.2	50
Pb	<0.0005	<0.0005	0.0007	2.2	50
Hg	0.00042	0.00048	0.00048	0.9	1.0
Ni	0.0008	0.0005	0.026	6.2	50
Zn	0.0058	0.0054	0.0059	19.6	75
Mn	0.003	0.002	0.199	166	-
COD	24.6	17.4	34.3	42,000	50,000
TKN	1.11	1.04	1.87	1,985	1,000
TVS	-	-	-	60,970	80,000
Oil and Grease	-	-	-	33.9	-

*Dry weight

Table G-12

Elutriate, Surface Water, and Bottom Sediment Data

Location - Sulphur River just northeast of Talco, Texas

Sample No.: 2
Lab I.D. No.: WQP 104
Record No.: WQP 104
Date: 12 March 1976
Time: 0920 hours

Source	Water Quality			Bottom Sediment	
	Elutriate	Surface Water Dissolved	Surface Water Total	Sample Concentration	EPA Region VI Criteria
	(mg/l)	(mg/l)	(mg/l)	(mg/kg*)	(mg/kg*)
Cd	<0.0001	<0.0001	0.0002	<0.01	2.0
Cr	0.001	0.001	0.006	20.7	100
Cu	0.0084	0.0072	0.0095	7.9	50
Pb	<0.0005	<0.0005	0.0013	3.9	50
Hg	0.00042	0.00034	0.00043	0.463	1.0
Ni	0.006	0.008	0.018	9.6	50
Zn	0.0044	0.0049	0.0059	30.1	75
Mn	0.001	0.003	0.255	181	-
COD	36.7	16.7	27.0	14,900	50,000
TKN	1.48	1.27	2.39	414	1,000
TVS	-	-	-	28,000	80,000
Oil and Grease	0	0	0	20.8	-

*Dry weight

Table G-13

Elutriate, Surface Water, and Bottom Sediment Data

Location - Sulphur River at Highway 271 Bridge

Sample No.: 3
Lab I.D. No.: WQP 105
Record No.: WQP 105
Date: 12 March 1976
Time: 1010 hours

	Water Quality			Bottom Sediment	
		Surface Water		Sample Concen-tration	EPA Region VI Criteria
Source	Elutriate (mg/1)	Dissolved (mg/1)	Total (mg/1)	(mg/kg*)	(mg/kg*)
Cd	<0.0001	<0.0001	0.0002	<0.01	2.0
Cr	0.002	0.001	0.020	8.23	100
Cu	0.0210	0.0248	0.0268	4.25	50
Pb	<0.0005	<0.0005	0.0014	1.76	50
Hg	0.00005	0.00005	0.00063	0.564	1.0
Ni	0.006	0.005	0.017	7.00	50
Zn	0.0049	0.0056	0.0069	42	75
Mn	0.003	0.002	0.220	147	-
COD	32.2	29.5	42.4	31,900	50,000
TKN	1.68	1.17	2.22	526	1,000
TVS	-	-	-	46,500	80,000
Oil and Grease	-	-	-	12.2	-

*Dry weight

Table G-14

Elutriate, Surface Water, and Bottom Sediment Data

Location - Sulphur River at Highway 37 Bridge

Sample No.: 4
Lab I.D. No.: WQP 106
Record No.: WQP 106
Date: 12 March 1976
Time: 1055 hours

	Water Quality			Bottom Sediment	
		Surface Water		Sample	EPA
Source	Elutriate	Dissolved	Total	Concentration	Region VI Criteria
	(mg/l)	(mg/l)	(mg/l)	(mg/kg*)	(mg/kg*)
Cd	<0.0001	<0.0001	0.0005	<0.01	2.0
Cr	0.003	0.001	0.058	28.5	100
Cu	0.0063	0.0041	0.010	4.74	50
Pb	<0.0005	<0.0005	0.0013	1.84	50
Hg	0.00048	0.00020	0.00034	0.222	1.0
Ni	0.005	0.003	0.022	6.64	50
Zn	0.0053	0.0031	0.0050	26.6	75
Mn	0.002	0.004	0.283	168	-
COD	24.2	21.4	31.9	23,600	50,000
TKN	1.88	1.30	2.39	526	1,000
TVS	-	-	-	23,100	80,000
Oil and Grease	-	-	-	22.6	-

*Dry weight

Table G-15

Elutriate, Surface Water, and Bottom Sediment Data

Location - Sulphur River at Highway 69 Bridge

Sample No.: 5
Lab I.D. No.: WQP 107
Record No.: WQP 107
Date: 12 March 1976
Time: 1150 hours

Source	Water Quality Elutriate (mg/l)	Surface Water Dissolved (mg/l)	Surface Water Total (mg/l)	Bottom Sediment Sample Concentration (mg/kg*)	Bottom Sediment EPA Region VI Criteria (mg/kg*)
Cd	<0.0001	0.0001	0.0002	<0.01	2.0
Cr	0.001	0.001	0.014	6.6	100
Cu	0.0103	0.0066	0.0084	0.2	50
Pb	<0.0005	<0.0005	<0.0007	2.2	50
Hg	0.00042	0.00048	0.00048	0.9	1.0
Ni	0.0008	0.0005	0.026	6.2	50
Zn	0.0058	0.0054	0.0059	19.6	75
Mn	0.003	0.002	0.199	166	-
COD	24.6	17.4	34.3	42,000	50,000
TKN	1.11	1.04	1.87	1,985	1,000
TVS	-	-	-	60,970	80,000
Oil and Grease	-	-	-	33.9	-

*Dry weight

Table G-16

Elutriate, Surface Water, and Bottom Sediment Data

Location - Sulphur River at Highway 154 Bridge

Sample No.: 6
Lab I.D. No.: WQP 108
Record No.: WQP 108
Date: 12 March 1976
Time: 1235 hours

	Water Quality			Bottom Sediment	
		Surface Water		Sample	EPA
Source	Elutriate	Dissolved	Total	Concentration	Region VI Criteria
	(mg/l)	(mg/l)	(mg/l)	(mg/kg*)	(mg/kg*)
Cd	<0.0001	<0.0001	0.0003	<0.01	2.0
Cr	0.001	0.001	0.047	12.7	100
Cu	0.0084	0.0032	0.0098	3.20	50
Pb	<0.0005	<0.0005	0.0009	3.98	50
Hg	0.00026	0.00026	0.00042	0.013	1.0
Ni	0.006	0.006	0.027	5.54	50
Zn	0.0051	0.0021	0.0186	23.4	75
Mn	0.001	0.003	0.124	213	-
COD	28.3	24.6	37.5	23,900	50,000
TKN	1.31	1.59	2.18	367	1,000
TVS	-	-		36,300	80,000
Oil and Grease	-	-		8.8	-

*Dry weight

Table G-17

Elutriate, Surface Water, and Bottom Sediment Data

Location - Sulphur River at Tira, Texas

Sample No.: 7
Lab I.D. No.: WQP 109
Record No.: WQP 109
Date: 12 March 1976
Time: 1300 hours

	Water Quality			Bottom Sediment	
		Surface Water		Sample	EPA
Source	Elutriate	Dissolved	Total	Concen-tration	Region VI Criteria
	(mg/l)	(mg/l)	(mg/l)	(mg/kg*)	(mg/kg*)
Cd	<0.0001	<0.0001	0.0004	<0.01	2.0
Cr	0.003	0.001	0.012	7.23	100
Cu	0.0021	0.0027	0.0077	1.48	50
Pb	<0.0005	<0.0005	<0.0005	3.12	50
Hg	0.00034	0.00042	0.00042	0.061	1.0
Ni	0.008	0.007	0.010	3.13	50
Zn	0.0063	0.0054	0.0064	13.4	75
Mn	0.037	0.008	0.045	113	-
COD	30.3	17.4	19.8	9,470	50,000
TKN	1.86	1.13	1.69	521	1,000
TVS	-	-	-	19,800	80,000
Oil and Grease	-	-	-	14.7	-

*Dry weight

Table G-18

Elutriate, Surface Water, and Bottom Sediment Data

Location - Sulphur River at Cooper, Texas

Sample No.: 8
Lab I.D. No.: WQP 110
Record No.: WQP 110
Date: 12 March 1976
Time: 1330 hours

	Water Quality			Bottom Sediment	
		Surface Water			
Source	Elutriate (mg/1)	Dissolved (mg/1)	Total (mg/1)	Sample Concentration (mg/kg*)	EPA Region VI Criteria (mg/kg*)
Cd	<0.0001	<0.0001	0.0005	<0.01	2.0
Cr	0.005	0.001	0.015	3.42	100
Cu	0.0093	0.0021	0.0075	0.64	50
Pb	<0.0005	<0.0005	0.0009	2.87	50
Hg	0.00020	0.00020	0.00102	0.047	1.0
Ni	0.008	0.003	0.013	8.62	50
Zn	0.0066	0.0024	0.0058	8.51	75
Mn	0.070	0.005	0.045	109	-
COD	36.7	29.5	30.2	20,100	50,000
TKN	2.37	1.20	1.51	336	1,000
TVS	-	-		16,300	80,000
Oil and Grease	-	-		14.2	-

*Dry weight

Table G-19

Elutriate, Surface Water, and Bottom Sediment Data

Location - Sulphur River at Cooper, Texas (Tucker's Cemetery)

Sample No.: 9
Lab I.D. No.: WQP 111
Record No.: WQP 111
Date: 12 March 1976
Time: 1330 hours

Source	Water Quality			Bottom Sediment	
		Surface Water			
	Elutriate	Dissolved	Total	Sample Concentration	EPA Region VI Criteria
	(mg/l)	(mg/l)	(mg/l)	(mg/kg*)	(mg/kg*)
Cd	0.0001	<0.0001	0.00016	0.01	2.0
Cr	0.002	0.001	0.012	14.9	100
Cu	0.0039	0.0036	0.0071	2.92	50
Pb	<0.0005	<0.0005	<0.0005	2.86	50
Hg	0.00042	0.00042	0.00056	0.065	1.0
Ni	0.004	0.006	0.041	7.48	50
Zn	0.0212	0.0106	0.0204	26.7	75
Mn	0.011	0.002	0.065	264	-
COD	29.5	22.2	25.4	33,600	50,000
TKN	2.21	1.36	1.49	493	1,000
TVS	-	-		38,400	80,000
Oil and Grease	-	-		23.6	-

*Dry weight

APPENDIX H

FISH AND WILDLIFE REPORT

Dated 3 September 1976

United States Department of the Interior
FISH AND WILDLIFE SERVICE
17 EXECUTIVE PARK DRIVE, N. E.
ATLANTA, GEORGIA 30329

September 3, 1976

District Engineer
U. S. Army, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

Reference is made to the Cooper Lake and Channels project, Texas. The purpose of this report is to recommend mitigation measures which we consider essential to compensate for wildlife losses created by the reservoir and downstream flood control features in the Sulphur River drainage. Our studies were conducted in cooperation with the Texas Parks and Wildlife Department and submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Fish and Wildlife Service has prepared two reports on the Cooper Lake and Channels project, first on July 13, 1966, and again on March 8, 1972, since the Corps of Engineers was given construction authority in an act approved August 3, 1955 (Public Law 318, 84th Congress, 1st Session). The current evaluation methods, the Ecological Planning and Evaluation Procedures, developed by the Joint Federal-State-Private Conservation Organization Committee in January 1974, were employed in the current study.

DESCRIPTION OF THE AREA

The authorized project is located in northeast Texas on the Sulphur River between the headwaters of North Sulphur, Middle Sulphur, and South Sulphur Rivers and Wright Patman Lake. The 90,000-acre project area is confined to the 30-year flood plain.

The project portion of the Sulphur River Basin lies within two major soil regions. The headwaters area in Hunt, Lamar, Delta and portions of Hopkins and Red River Counties lies in the

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

Blackland Prairie, while the remaining eastern counties of Franklin, Titus, Morris, and Bowie Counties occur in the East Texas Timber Country. The Blackland soils are heavy textured, dark, and deeply developed from marl and chalk, mainly of Upper Cretaceous formations. This smooth to gently rolling surface topography was extensively cultivated in the past. Historically cotton has been the chief agricultural crop; however, corn, hay, wheat, oats, sorghums, and other feed crops are the major uses of this area at present.

The Eastern Timber soils, which occur in the eastern, downstream portions of the project area are mostly light colored sandy topsoils which are generally loose, more or less acid and low in organic matter. Most of the land in the region is used for timber and native and improved pasture.

Sulphur River is the major drainage system in the project area, draining approximately 1,956 square miles. The major branches forming the headwaters of the Sulphur River include North Sulphur, Middle Sulphur, and South Sulphur Rivers. The Middle Sulphur and South Sulphur Rivers converge east of Commerce, Texas, and the North Sulphur River joins approximately 15 miles west of Talco, Texas. Two major tributaries, Brushy Creek and Cuthand Creek, also provide inflow below the confluence of Sulphur River and North Sulphur River.

The Sulphur River channel modification and enlargement-extension of existing levees and construction of appurtenant drainage works along the main stream above river mile 120 were about 55 percent complete prior to the temporary injunction in 1971; however, no construction was conducted from river mile 120 to Cuthand Creek. Channel and levee work is complete on the Sulphur River from the confluence of the North Sulphur and Sulphur Rivers to State Highway 37, and channels are complete from State Highway 37 to U. S. Highway 271. Six miles of channels are also completed downstream from river mile 170, and the 150-foot floodway is cleared from mile 170 to the mouth of Cuthand Creek. Levee and channel works on North Sulphur River and Brushy and Cuthand Creeks are almost completed.

Streams and adjacent banks affected by project alterations have been straightened and support a limited diversity of plant species. Dominant overstory trees include black willow, cottonwood, box elder, hackberry, Osage orange, and several vine species such as grape, rattan, trumpet creeper, and peppervine. In many areas woodland vegetation is confined mainly to the immediate streambank due to clearing practices. The natural streams of the project

area are meandering with banks supporting an extensive overstory and midstory of oak, hickory, ash, and locust species; possum haw, box elder; and numerous grape, rattan, American buckwheat, and peppervines. Unaltered stream segments in comparison to altered portions incompass large woodland tracts and numerous oxbows within the natural flood plain.

Fish and wildlife resources in the vicinity of the proposed reservoir and downstream area are plentiful and diverse due to the variety of aquatic and terrestrial habitats. While fishery resources are limited by narrow channels and seasonal low flows above the damsite, areas downstream support an abundance of forage, game and rough fish. Below the confluence of North Sulphur and South Sulphur Rivers, the stream has altered its course many times, leaving numerous oxbow lakes and sloughs. These lakes and the Sulphur River are connected during periods of high water, thus enabling natural restocking and nutrient exchange. These lakes also serve as spawning and rearing ponds for many species of fish.

Based upon fishery studies conducted by Texas Parks and Wildlife Department personnel in 1954 and 1955, fish populations are dominated by such forage fishes as gizzard shad, golden and red shiner, blackstripped topminnow, gambusia, and bluntnose and swamp darters. Primary sport fishes include largemouth and spotted black bass, white and black crappie, warmouth, bluegill, and green, longear, orangespotted and redear sunfishes, and flier. Bowfin, shortnose and longnose garfish; smallmouth and bigmouth buffalofish; channel, blue, and flathead catfish; yellow and black bullhead; and freshwater drum are significant in that they are harvested by both sport and commercial fishermen.

Sport fishing is an important form of recreation to residents of the project area. Large, permanent pools within the central and lower reaches of the Sulphur River and adjacent lakes and sloughs are very productive and attract many sportsmen where access is available. Commercial fishing for catfishes, buffalofishes, and freshwater drum also provide an income to commercial fishermen within the basin.

Wildlife resources occur in moderate to high populations within the various habitat types. The pastures and croplands which occur primarily within the reservoir site and upper portions of the project channels support huntable populations of bobwhite quail, mourning dove, and cottontail rabbit. Many nongame species including songbirds, raptors, and small mammals are present. Semi-wooded pastures and bottomland hardwoods associated with the flood plain provide

excellent habitat for numerous game and nongame species. White-tailed deer, fox squirrels, raccoon, cottontail rabbits, swamp rabbits, opossum, mink, beaver, and resident wood ducks occur in moderate to high numbers within these woodland and riparian ecosystems. Resident wood ducks and migrating waterfowl and American woodcock are also benefited by seasonal flooding of flood plain woodlands and cleared lands during the winter and spring months. Many species of songbirds, nongame mammals, reptiles, and amphibians are present due to the natural flooding conditions and excellent food and cover available.

Based upon man-day hunting use data contained in our 1966 report, hunting is very popular within the project area. However, lack of public access is the primary deterrent to greater consumptive use of both fish and wildlife resources. Nonconsumptive uses of these resources including birdwatching, nature study, and photography are also enjoyed by local residents in areas where access is available.

The American alligator is a resident endangered wildlife species within the Sulphur River Basin, and the southern bald eagle, peregrine falcon, and whooping crane possibly transit the basin during migration. The approximate 16,000-acre Arkansas Game and Fish Commission-owned Sulphur River Wildlife Management Area, located on the Sulphur River below Wright Patman Lake, affords habitat for the endangered American alligator, migratory waterfowl, and a diversity of resident wildlife while overflow lakes and sloughs support a viable population of native, warm-water fishes. Alligator releases during 1971-1973, as a part of the Commission's endangered species management program, has augmented the prior alligator population. The State of Arkansas has determined the Sulphur River Wildlife Management Area to be critical habitat for the American alligator and has requested the Secretary of the Interior to enjoin the State in this determination.

Low flow, oxygen deficient releases of 10 c.f.s. from Wright Patman Lake and waste water discharges by the International Paper Company have degraded water quality in the lower Sulphur River and the Sulphur River Wildlife Management Area in the past several years resulting in fish kills and hampering navigation for small boats within the State-owned area.

DESCRIPTION OF THE PROJECT

The authorized project includes construction of a 15,851-foot earthen dam, a 200-foot gate controlled spillway, a 4,200-foot

emergency spillway, and appropriate flood control outlet works to be located at river mile 23.2 on the South Sulphur River. The Cooper Lake Reservoir will extend to about river mile 42 when filled to the level of the spillway crest.

The primary purposes of the reservoir are flood control, municipal and industrial water supply, and recreation. The project plans for Cooper Lake include future development of seven public use sites containing 3,300 acres for recreation and access to the reservoir. We also understand approximately 6,000 acres of project lands could be devoted to fish and wildlife purposes. The reservoir take-line including the damsite, reservoir, and lands above the flood pool would require 30,000 acres. Minimum downstream releases from Cooper Lake would be 5 c.f.s. Flood water release to a maximum of 3,000 c.f.s. would occur when water within the reservoir exceeds 440 feet mean sea level. Pertinent reservoir data are shown in table 1.

Development of flood control storage in Cooper Lake would permit 120,000 acre-feet of flood storage at Wright Patman Lake to be reallocated to water supply. This additional municipal and industrial water supply would be contracted to the city of Texarkana, Texas, for use by the International Paper Company for dilution of their effluent discharge to the Sulphur River. Based upon the Corps' draft environmental statement on the enlargement of Wright Patman Lake, dated June 23, 1971, the additional water supply storage would create a 9,000-acre increase in the surface acres of Wright Patman Lake.

A continuation of the present minimum discharge of 96 c.f.s. between May and October is expected below Wright Patman Lake when water elevations within the reservoir equal or exceed 220.0 feet MSL (water supply pool). However, when water elevations are less than 200 feet MSL, discharges would be likewise reduced to 10 c.f.s. Maximum flood releases would be 10,000 c.f.s.

Below the Cooper Lake damsite, channel enlargement to river mile 120.1, floodway and levee construction and improvement of existing levees not previously completed would require 1,500 acres of flood plain lands to meet the flood control objectives. The approximate 35 miles of uncompleted channel enlargement would be excavated to a minimum bottom width of 12 feet and have a 1 on 1 side slope. A floodway 150 feet in width will be cleared along the entire length of the channel aligmment. Upon completion, 102 miles of natural stream will be bypassed by 54 miles of new channel. Completion of

TABLE 1

Pertinent Reservoir Engineering Data
Cooper Lake

Description	Storage Capacity acre-feet	Elevation feet MSL	Surface Area acres
Sedimentation Pool	37,000	415.5	5,084
*Water Supply Pool	273,000	440.0	19,305
Flood Control Pool	131,400	446.2	22,740

*This would also be the same for the recreation pool.

TABLE 2

Pertinent Engineering Data
On Other Flood Control Works Above And
Below The Cooper Lake Reservoir

Description	Above Reservoir Miles	Below Reservoir Miles	Uncompleted Miles
Levees	9.4*	66.8	63.6
Channels	21.0*	56.9	35.0

*Completed

29.9 miles of new levees and enlargement of 33.7 miles of existing levees below the dam, between the reservoir and the mouth of Cuthand Creek, are planned. Pertinent data on levee and channel features is shown in table 2.

The 100-year project life span is 1980-2080.

PROJECT IMPACT

The authorized Cooper Lake Reservoir and channel/levee features would have a significant adverse effect on terrestrial and aquatic habitats within the project area.

The proposed reservoir would permanently inundate or destroy 6,786 acres of cleared land, 5,220 acres of semi-wooded land, and 5,394 acres of bottomland hardwoods within the 17,400-acre average annual permanent pool; thus creating a 100 percent terrestrial loss on the area involved. The flood pool would reduce the value of terrestrial habitats by 50 percent on 2,125 acres of cleared land, 1,602 acres of semi-wooded land, and 1,613 acres of bottomland hardwoods. The lands between the flood pool and project boundary would undergo a 10 percent reduction in habitat value due to recreational development and intensive public use on the 2,827 acres of cleared land, 2,165 acres of semi-wooded land and 2,160 acres of bottomland hardwoods.

The damsite, spillways, and appropriate flood control outlet works would eliminate approximately 62 acres of existing cleared land, 13 acres of semi-wooded land, and 25 acres of bottomland hardwoods. The construction alterations and use of this area for project purposes would incur an estimated 10 percent habitat value loss on existing cleared lands and impose a 35 and 50 percent loss on affected semi-wooded land and bottomland hardwoods respectively.

Induced clearing of downstream semi-wooded and bottomland hardwood areas within the flood plain by private landowners due to flood protection afforded by the reservoir would adversely affect wildlife populations by converting woodland habitat types to less productive cleared lands of lower habitat value. Based upon information provided by the Corps of Engineers, 1,500 acres of semi-wooded land and 2,560 acres of bottomland hardwoods would be cleared.

The channels, levees, floodways, and other rights-of-way features proposed below the Cooper Lake damsite for agricultural flood control and conveyance of reservoir releases would require 200 acres

of cleared land, 100 acres of semi-wooded land and 1,200 acres of bottomland hardwoods. Alteration of these terrestrial habitats would incur a 10 percent reduction in habitat value on cleared land and 25 and 50 percent on semi-wooded land and bottomland hardwoods respectively.

Induced clearing resulting from the flood protection provided by the levee and channel features would cause an estimated 1,700 acres of semi-wooded land and 6,720 acres of bottomland hardwoods to be converted to cleared land of lower habitat value. Induced clearing resulting from the project is expected to be accomplished by the tenth year following project construction.

The inundation of at least 9,000 acres of terrestrial habitat adjacent to the existing Wright Patman Lake to accommodate the additional 120,000 acre-feet of water supply storage would have an adverse impact on terrestrial wildlife populations in the areas affected.

Aquatic resources upstream and downstream of the Cooper Lake damsite will also be affected by the proposed project. The inundation of 21 miles of natural stream by the reservoir would eliminate many species of fish which occur only under stream conditions. The reservoir, however, would significantly increase the potential for those fish species which thrive within reservoirs.

Channel alterations between the Cooper Lake damsite and Wright Patman Lake will eliminate undercut banks, natural stream barriers, bottom substrate and riparian vegetation. Reduced water elevations within the stream due to reservoir impoundment upstream and minimum release of only 5 c.f.s. will greatly reduce the ability of the stream to support a productive sport and commercial fishery. Oxbow lakes created by the realignment of the natural channel are expected to support a moderate fishery during the early portion of the project life; however, due to induced sediment, siltation, reduced water volume, and significant reduction of fish recruitment and nutrient exchange between the stream and the oxbow cutoffs, the productivity of these lakes will be adversely affected.

Water quality degradation resulting from minimum flow releases of 10 c.f.s. of oxygen deficient water from Wright Patman Lake and waste water discharges by the International Paper Company will continue to limit fish and wildlife productivity in the lower Sulphur River.

DISCUSSION

During the month of May 1976 biologists of the U. S. Fish and Wildlife Service and the Texas Parks and Wildlife Department conducted field evaluations of terrestrial wildlife habitats in the project area. The guidelines provided by the Ecological Planning and Evaluation Procedures were used to evaluate the existing habitats (specifically bottomland hardwoods, semi-wooded native pasture and cleared land). Sample plots representative of each habitat type were randomly selected from quadrangle maps with access being a contributing factor. The habitat quality of each sample plot was assessed by the biologists and a quality index (habitat units per acre) was assigned.[1] Using project data provided by the Corps of Engineers, an analysis of the project impacts on each of the habitat types was then determined and the results recorded in habitat units lost or gained.[2] A summary of the effects of the project on terrestrial habitats is expressed in habitat units in tables 3 and 4. To assist your planning staff, the reservoir and downstream features above Wright Patman Lake were evaluated separately.

As it may be difficult to visualize the magnitude of a habitat unit in absolute terms, the reservoir and downstream features are expressed in terms of acreages required under intensive management to compensate for loss of terrestrial wildlife habitat and wildlife productivity over the life of the project in table 5.

----

1. "Ecological Planning and Evaluation Procedures," (Preliminary Draft). Developed by the Joint Federal-State-Private Conservation Organization Committee, Washington, D.C. January 1974.

2. Basic field data and evaluations have not been included in this report but are available upon request.

TABLE 3

Summary of Reservoir Effects on
Land Use and Wildlife Resources

Habitat Affected	Area Affected acres	Effect on Wildlife (Habitat Units) Annualized	Total
Cleared land	11,800	- 22,872	- 2,287,200
Semi-wooded land	10,500	- 29,800	- 2,980,000
Bottomland hardwoods	11,752	- 47,965	- 4,796,500

TABLE 4

Summary of Effects By Levee, Channel, Floodway, And
Other Works Below the Reservoir On Land Use And Wildlife Resources

Habitat Affected	Area Affected acres	Effect on Wildlife (Habitat Units) Annualized	Total
Cleared land	200	- 86	- 8,600
Semi-wooded land	1,800	- 2,755	- 275,500
Bottomland hardwoods	7,920	- 25,959	- 2,595,900

TABLE 5

Required Acreage Under Intensive Management To
Compensate for Terrestrial Losses by Major Project Feature

Reservoir	Approximately 31,300 acres
Levees, channels, floodway, and other rights-of-way requirements	Approximately 11,600 acres

The specific mitigation lands could not be identified in the time constraints of this study; however, we believe a joint study by representatives of the U. S. Fish and Wildlife Service, Texas Parks and Wildlife Department, and Corps of Engineers should be initiated as soon as practicable to locate the most suitable areas for mitigation. It would also seem desirable to provide mitigation measures in the proximity of those resources affected. Therefore, those habitats destroyed or damaged by the authorized project should be compensated for by acquisition of mitigation lands within the Sulphur River drainage. Based upon our field evaluations, the tract of bottomland hardwoods within the lower reaches of the project area would possibly provide a desirable mitigation area for damages resulting from project construction. Assuming suitable mitigation land is available, the exact acreage required could be greater or lesser than the 42,900 acres specified, depending on the similarity of the mitigation land and that affected by project construction and related land use changes.

To protect the integrity of potential mitigation lands and derive the greatest public benefits of land acquired for mitigation, the acquisition of all lands should be in fee title and completed prior to or concurrent with project construction.

Development, operation, and maintenance of mitigation lands would also be required to compensate for project losses as mere acquisition of land would not afford any significant habitat improvements. Therefore, the costs of obtaining and maintaining the management potential of mitigation land should be considered a project feature funded by the construction agency.

Aquatic ecosystems below the reservoir will be greatly affected by the proposed channel alterations and decreased streamflow characteristics. Therefore, every alternative should be considered in order to lessen these project impacts. This should include the preservation of the natural stream through the installation of water control structures at the junction of man-made and natural stream channels. These structures would divert normal streamflows through the natural channels, utilizing the proposed channels as auxiliary floodways to convey flood water releases and runoff.

Minimum flow releases of 5 c.f.s. would significantly reduce the ability of the stream to support aquatic life and provide a productive fishery resource. Dewatering of the stream system would, in addition to reducing water volume, limit nutrient inflow from headwater drainage above the reservoir, alter the natural abundance

of pool and riffle areas and reduce the nutrient exchange and reproductive capabilities between the Sulphur River and its adjoining tributaries and oxbow lakes. To provide a more natural streamflow which would minimize the impact of dewatering the Sulphur River, minimum flow releases below Cooper Lake should be modified to permit flows to at least equal or exceed the median monthly flow or 10 c.f.s., whichever is greater.

To determine the impact and mitigation needs resulting from the enlargement of Wright Patman Lake due to the increased water supply storage, a separate study should be initiated prior to the lake enlargement. Habitat evaluation procedures similar to those used by this Service at the Cooper Lake and channels project site would provide your agency with acreages of similar habitat types required to compensate for project losses of wildlife habitat.

Minimum flow releases of 10 c.f.s. at Wright Patman Lake have contributed to lowered water quality, fish kills, and general degrading of fish and wildlife productivity in the lower Sulphur River. A minimum flow release of not less than 100 c.f.s. and higher flows from mid-October through December of each year would be a significant step toward improving the water quality and fish and wildlife habitats in this important ecological area of Texas and Arkansas.

RECOMMENDATIONS

Based upon the results of this restudy which primarily addresses the mitigation needs of the Cooper Lake and Channels project, the U. S. Fish and Wildlife Service recommends:

1. An interagency study be initiated to locate the most suitable areas for acquiring the mitigation acreages required to compensate for project wildlife losses.

2. The Corps of Engineers seek congressional authorization for mitigation lands acceptable to the Federal and State fish and wildlife agencies and the Corps of Engineers prior to the continuation of project construction.

3. Mitigation lands be purchased in fee title prior to or concurrent with project completion in order that all lands selected for mitigation purposes be protected from induced clearing.

4. Development, operation, and maintenance costs of managing mitigation lands be borne by the project.

5. Water control structures be installed at the juncture of manmade and natural stream channels to divert normal streamflows through natural stream segments.

6. Minimum instantaneous downstream releases be at least equal to or exceed the median monthly stream flow or 10 c.f.s., whichever is greater.

7. A study be initiated to determine the impact and mitigation requirements of Wright Patman Lake enlargement prior to increasing water supply storage.

8. Minimum instantaneous downstream releases below Wright Patman Lake be increased to 100 c.f.s. with higher flows from mid-October through December each year.

This report has been reviewed and concurred in by the Texas Parks and Wildlife Department. A copy of Executive Director Garrison's letter of concurrence is attached.

We appreciate the opportunity to provide these comments and request this report be appended to the final environmental statement.

Sincerely yours,

Kenneth E. Black

Regional Director

Attachment

TEXAS
PARKS AND WILDLIFE DEPARTMENT

CLAYTON T. GARRISON
EXECUTIVE DIRECTOR

JOHN H. REAGAN BUILDING
AUSTIN, TEXAS 78701

August 19, 1976

Regional Director
U. S. Fish and Wildlife Service
17 Executive Park Drive, N.E.
Atlanta, Georgia 30329

Dear Sir:

The Texas Parks and Wildlife Department has reviewed a preliminary draft copy of the U. S. Fish and Wildlife Service's Letter Report on the Cooper Lake and Channels Project of the Corps of Engineers. This report was forwarded to us following a telephone conversation with the Vicksburg Office of the U. S. Fish and Wildlife Service wherein we were requested to expedite review of this document. We are in agreement with the findings of the advanced copy of this report and wish to have this letter serve as our letter of concurrence provided that no substantive changes are made in the final letter report.

There appears to be some general misunderstanding regarding the 42,900 acres determined to be necessary for compensation using the Principles and Standards Evaluation methodology and the actual recommendations of the U. S. Fish and Wildlife Service for mitigation of project induced losses of wildlife habitat. It is our understanding that an actual acreage figure for project mitigation has not been determined at this time and is subject to negotiations between the various agencies concerned. This matter should be clarified in the letter report. Also, this Department would appreciate the opportunity to participate in an interagency study team to investigate mitigation land as suggested in the letter report.

We wish to call to your attention the presence of two significant natural areas in the project area which are identified in the Texas Outdoor Recreation Plan. The Horton Bottom is a five square mile area located on the north branch of the South Sulphur River occupying a zone one mile wide from Highway 1531 to the confluence of Merrit Creek. This area is noted for the occurrence of archaeological sites and nutmeg hickory (Carya myristicaeformis). The Sulphur River Basin extending in a zone one-half to one mile wide through Bowie, Delta, Red River, and Titus Counties is recognized for its flood plain forest, high populations of wildlife, and numerous lakes and sloughs.

Regional Director
August 19, 1976
Page Two

The Ark-Tex Council of Governments has proposed a trail system which could connect Cooper Reservoir and its recreational facilities with facilities at Wright Patman Lake. This proposal should receive consideration in future planning of the Cooper Lake and Channels Project.

Thank you for allowing us to review the preliminary draft report for this project.

Sincerely,

Clayton Garrison

CLAYTON T. GARRISON
Executive Director

CTG:MW:pm

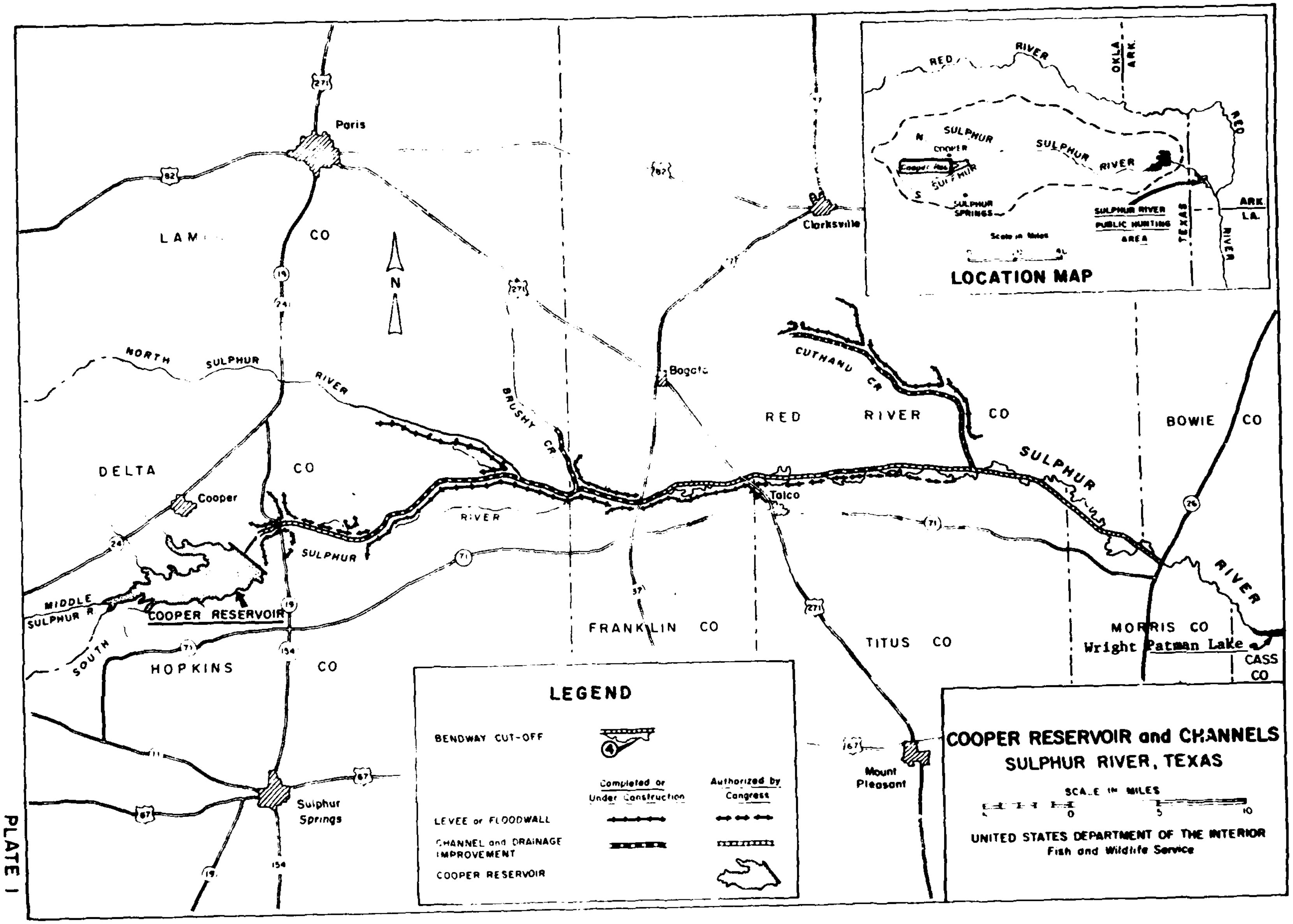

COOPER RESERVOIR and CHANNELS
SULPHUR RIVER, TEXAS
SCALE IN MILES
0
5
10
UNITED STATES DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
LEGEND
BENDWAY CUT-OFF
Completed or Under Construction
Authorized by Congress
LEVEE or FLOODWALL
CHANNEL and DRAINAGE IMPROVEMENT
COOPER RESERVOIR
LOCATION MAP
RED RIVER
OKLA
ARK.
LA.
TEXAS
SULPHUR
SULPHUR RIVER
SULPHUR SPRINGS
SULPHUR RIVER PUBLIC HUNTING AREA
Paris
LAM
CO
DELTA
Cooper
NORTH SULPHUR RIVER
MIDDLE SULPHUR R
SOUTH
COOPER RESERVOIR
HOPKINS
Sulphur Springs
BRUSHY CR
Bogata
Clarksville
CUTHAND CR
RED RIVER CO
FRANKLIN CO
Talco
TITUS CO
Mount Pleasant
BOWIE CO
SULPHUR
RIVER
MORRIS CO
Wright Patman Lake
CASS CO
N

PLATE I

APPENDIX I
LETTERS RECEIVED BY THE DISTRICT ENGINEER ON THE
DRAFT ENVIRONMENTAL STATEMENT

Advisory Council
On Historic Preservation
1522 K Street N.W.
Washington, D.C. 20005

June 25, 1976

Lieutenant Colonel L. A. Hubert, Jr.
Acting District Engineer
Corps of Engineers, New Orleans District
Department of the Army
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Hubert:

This is in response to your request of June 10, 1976, for comments on the draft environmental statement (DES) for Cooper Lake and Channels, Texas. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council has determined that the DES appears adequate concerning compliance with Section 106 of the National Historic Preservation Act of 1966.

However, with respect to compliance with Executive Order 11593, "Protection and Enhancement of the Cultural Environment" issued May 13, 1971, we note that the project will result in adverse effects to ninety cultural resources possessing archeological significance, which may be eligible for inclusion in the National Register of Historic Places.

Therefore, in accordance with Section 2(b) of the Executive Order 11593 and Section 800.4(a)(2) of the "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800), the Council requests the Corps of Engineers to request in writing an opinion from the Secretary of the Interior respecting these properties' eligibility for inclusion in the National Register and inform us of the findings. The Corps is reminded that should the Secretary of the Interior determine the properties are eligible for inclusion in the National Register, it is required to obtain the Council's comments pursuant to Section 800.4(e) of the procedures prior to proceeding with any portion of the undertaking which will affect the cultural resources.

The Council is an independent unit of the Executive Branch of the Federal Government charged by the Act of October 15, 1966 to advise the President and Congress in the field of Historic Preservation

Until the requirements of the Executive Order 11593 and the procedures are met, the Council considers the DES to be incomplete in its treatment of cultural resources. To remedy this deficiency, the Council will provide substantive comments on the undertaking's effect on the above cited cultural resources through the process set forth in the procedures. Please contact Michael H. Bureman at P. O. Box 25085, Denver, Colorado 80225 or telephone number (303) 234-4946 to assist you in completing this process as expeditiously as possible so as to avoid any unnecessary delays in the implementation of the project.

Your continued cooperation is appreciated.

Sincerely yours,

Louis S. Wall
Louis S. Wall
Assistant Director, Office
of Review and Compliance

cc: Dr. Clement M. Silvestro, Chairman, Advisory Council
Mr. Truett Latimer, Texas State Historic Preservation Officer
Mr. Richard G. Leverty, Department of the Army
Mrs. Marilyn Klein, Council on Environmental Quality

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
826 FEDERAL OFFICE BUILDING
AUSTIN, TEXAS 78701

June 25, 1976

IN REPLY REFER TO

06-48.10A

Draft Environmental Statement
Cooper Lake and Channels, Texas

Lieutenant Colonel L. A. Hubert, Jr.
Acting District Engineer
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Hubert:

Your letter of June 10, 1976, submitted the draft environmental statement for the Cooper Lake and Channels, Texas project.

We offer the following comments for your consideration:

1. It is noted that the proposed project will require the relocation or alteration of several roads and bridges. More specific information on the relocation of the roads and bridges is needed. Also, vicinity and detailed maps showing proposed channel work in relation to highway facilities would be helpful.

2. The statement should indicate the extent and magnitude of the change to the Sulphur River (upstream and downstream of the project system) resulting from (a) the impoundment of water by Cooper Lake and (b) the channel rectification downstream of the reservoir.

3. The statement should also discuss whose responsibility it will be to correct or modify bridges and highways in the future resulting from aggradation upstream of the reservoir, degradation downstream (due to channelization) and possible aggradation (as the river deposits the eroded material).

Sincerely yours,

George H. Nelson

FOR John L. Conrado
Division Administrator

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL

BUREAU OF LABORATORIES
VECTOR BORNE DISEASES DIVISION
POST OFFICE BOX 2087
FORT COLLINS, COLORADO 80522

July 6, 1976

Colonel L. A. Hubert, Jr.
Acting District Engineer
New Orleans District, Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Re: LMNPD-RE

Dear Colonel Hubert:

We have reviewed the draft environmental statement on Cooper Lake and Channels, Texas, and we are submitting our comments regarding possible vector-borne disease impacts. We have found that vector impacts have not been adequately considered, and we believe that provisions should be made for the control of vector problems which might be created by the project.

Water resources projects have been shown to create extensive vector mosquito-producing habitats unless proper planning to preclude these conditions is done in the early stages of a project. The production of large vector populations increases the risks of vector-borne disease transmission to both humans and animals. The increased risk of diseases should be considered an adverse impact. The prevention of vector problems, by environmental manipulation, can be accomplished by proper planning, construction, and maintenance, and the inclusion of this type of information in the EIS can be shown as a beneficial effect. Benefits to human health and social well-being, such as vector mosquito control, are commonly overlooked.

Thirty-seven human cases of mosquito-borne encephalitis occurred in Texas in 1975. Because of arboviral activity in the state, provisions should be made for minimizing or precluding additional vector mosquito-producing habitats. The omission of vector control considerations on any water resources project is an error of considerable public health importance. For completness of the potential impact upon human health, surveillance and control of vector mosquitoes should be discussed in the final EIS.

The subject EIS, page II-65, under "Insects," states that some insects "are considered pests and are destructive to man and his endeavors..." Further, on pages C-45 and 46, the impact of the project on the reservoir

and the downstream area is listed as moderate for Culex, Anopheles, Culiseta, Aedes, Orthopodomyia, Psorophora, and Toxorhynchites species. On some reservoirs we have surveyed, particularly those not properly prepared before impounding, the impact of Culex, Aedes, Culiseta, and Anopheles species has been extensive. All of the above genera are known vectors in Texas. Therefore, the sponsoring agency should include plans and implement methods for avoiding the creation of additional vector-producing habitats. To reduce the potential for disease outbreaks and the need for emergency chemical control measures, vector prevention and surveillance need to be considered. The following questions should be answered in order to minimize adverse impacts of increased vector-borne disease risks. Which vector mosquito species are found in the project locality, and which ones could be associated with the reservoir? What steps are being taken to minimize breeding areas? What provisions are made for routine inspections and the control of mosquito larvae on the project? Perhaps some insight to these questions can be obtained from Mr. Kenneth Lauderdale, Director, Vector Control Division, Texas State Department of Health, 1100 West 49th Street, Austin, Texas 78756. He should be contacted in this regard.

We are glad to cooperate with your office in the review of the Cooper Lake project. We hope that appropriate plans for vector mosquito control can be implemented, and if we can be of any further assistance, please let us know.

Sincerely yours,

Richard O. Hayes

Richard O. Hayes, Ph.D., M.P.H.
Chief, Water Resources Branch

cc:
Mr. Samuel W. Hoover
Mr. Kenneth Lauderdale

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

1720 Peachtree Road, N. W.
Atlanta, Georgia 30309

8400
August 4, 1976

Colonel L. Hubert, Jr.
Acting District Engineer
New Orleans District
Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Hubert:

Here are United States Forest Service, State and Private Forestry comments on the draft environmental statement entitled, "Cooper Lake and Channels, Texas".

The sizeable acreage of bottomland hardwoods which would be lost as a direct and indirect result of project implementation is of concern to the Forest Service. This complex and sensitive ecosystem is an extremely valuable and rare ecological resource in this area. The flora and fauna of the bottomlands have evolved and adapted to present conditions of periodic flooding over eons of time. Any change--even the partial drainage proposed in this project--will result in the ultimate destruction of this total bottomland hardwoods ecosystem.

The impacts of the destruction of this resource are not fully disclosed and analyzed in the draft statement as to:

1. the limited acreage of bottomland hardwoods remaining in the area, in Texas and in the Nation.

2. the percentage of the area's limited bottomland hardwood acreage which would ultimately be lost in project implementation.

3. wood production (based on site capability) which would be lost from project induced clearing and drainage over a 200-year period (100-year project plus minimum 100-year recovery period).

4. the effect of the wood production loss on local industry in an agricultural economy.

6200-11 (1/69)

5. energy costs of the natural production of these bottomlands (wildlife, water, wood, recreation, etc.) versus un-natural and forced agricultural production.

6. and social, aesthetic, educational and scientific effects.

The statement discloses that considerably more flood protection will be provided by the approved reservoir than by the levees and channel facet of the plan. Proposed channelization, under the channel facet, will greatly accelerate silting in Wright Patman Lake and destroy irreplaceable river bottomlands. As a consequence, the environmental and economic costs of the levees and channel facet of the proposal appear disproportionate to purported project benefits. Therefore, we recommend a separate assessment of the levees and channel portion of the proposal--strictly on its own merits.

You attention is called to a stand of American Chestnut trees, Castanea dentata, located in the project area near the community of Box Elder. This small stand is one of the few remaining seed sources and hopes for perpetuation of the near-extinct American Chestnut species. Every precaution should be exercised to prevent any change in the soil-moisture regime of this mature stand of extremely rare trees.

Thank you for the opportunity to review and comment on this draft EIS.

Sincerely,

ROBERT K. DODSON
Area Environmantal Coordinator

Copy: State Forester, Texas

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE
1114 COMMERCE STREET
DALLAS, TEXAS 75202

OFFICE OF
THE REGIONAL DIRECTOR

August 5, 1976

Our Reference: EI# 0176-692
Cooper Lake and Channels, Texas

New Orleans District, Corps of Engineers
ATTN: LMNPD-RE
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

Pursuant to your request, this office has completed a Departmental review of the Environmental Impact Statement in accordance with the provisions of Section 102(2)(C) of P.L. 91-190 and the Council on Environmental Quality Guidelines of April 23, 1971.

Environmental health program responsibilities and standards of the Department of Health, Education, and Welfare include those vested with the United States Public Health Service and the Facilities Engineering and Construction Agency. The U.S. Public Health Service has those programs of the Federal Food and Drug Administration (milk, food, interstate travel and shellfish sanitation) and of the Health Services and Mental Health Administration, which include the Bureau of Community Environmental Management (housing hygiene, injury control, recreational health, and insect and rodent control) and the National Institute of Occupational Safety and Health.

Attached are comments and reactions to the Environmental Statement made by departmental agencies concerned with environmental health aspects of the project.

We thank you for the opportunity to coordinate our mutual environmental interests as they relate to this project proposal.

Sincerely,

D. Dean Blue

D. Dean Blue, P. E.
Regional Environmental Officer
Facilities Engineering and
Construction

Enclosures

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Reaction Review and Comments on Environmental Impact Statement for Project Proposal:

Draft Environmental Impact Statement Reviewed with Objections [ ]

Draft Environmental Impact Statement Reviewed with No Objections [X]

Date: August 2, 1976 EI#: 0176-692

Agency/Bureau: HEW/PHS

Project Proposal: Cooper Lake and Channels, Texas

Comments: We support the concern expressed by Dr. Richard Hayes, Vector-Borne Diseases Division, U. S. Public Health Service, Fort Collins, Colorado, in his reply of July 6, 1976 that vector impact and control by more adequately considered.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 648
Temple, Texas 76501

August 6, 1976

Mr. L. A. Hubert, Jr.
LTC, CE
Acting District Engineer
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Mr. Hubert:

We have reviewed the draft environmental statement for Cooper Lake and Channels, Texas. The following comments are being submitted for your consideration in preparation of the final draft:

1. Page II-5, first paragraph, last sentence - Suggest changing the sentence to read, "The bottomland soils are loamy to clayey".

2. Page II-5, last paragraph, fifth sentence - Suggest changing the sentence to read, "Drainage ranges from moderately well to poor".

3. Page II-61, (b) Post Oak Savannah - The second sentence which reads "The forest type is primarily an oak-hickory complex ...." could be changed to read "The woody vegetation is primarily oak-hickory...." The reason for this change is that this area is considered a savannah under climax conditions and thus is not a forest.

   The last sentence of the same paragraph - Suggest changing the word "forests" to "woods" for the same reason as above.

4. Page II-123, first sentence - Change "Soil Conservation Service" to "Soil and Water Conservation Districts". The board of directors are local landowners that are elected to serve as directors of the local Soil and Water Conservation District.

5. Page II-138, first paragraph - All of the drainage into the Sulphur River from the north lies in the Northeast Texas RC&D Project which was approved for operations on June 29, 1975. This project contains proposals for the treatment of the critical areas in the project area. This would greatly reduce sedimentation in the reservoir as well as to downstream areas.

6. Page IV-4, 2. b. Agricultural lands - Suggest including information on the acreage of cropland, crops produced and estimated yields.

7. Page IV-19 and IV-29, Agricultural lands - Suggest giving a breakdown of the agricultural lands into the acreages of grazing land and cropland.

8. Page VIII-1, 8.01 and 8.02 - Suggest including the acreage of cropland that will be altered by the proposed project.

9. There is no reference to the types, extent and impact of wetlands in the project area according to USDI, Fish and Wildlife Service Circular 39, Wetlands of the United States.

We appreciate the opportunity to review this draft and make appropriate comments.

Sincerely,

George C. Marks

George C. Marks
State Conservationist

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

August 10, 1976

Colonel Early J. Rush III
District Engineer
US Army Engineer District, New Orleans
Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Colonel Rush:

This is in reference to your draft environmental impact statement entitled "Cooper Lake and Channels, Texas." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving five (5) copies of the final statement.

Sincerely,

Sidney R. Galler
Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosures - (1) Memo, National Ocean Survey, July 29, 1976
(2) Memo, Environmental Data Service, July 14, 1976

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL DATA SERVICE
Washington, D.C. 20235

JUL 15 1976

July 14, 1976

Dx61/DLEC

TO: William Aron, Director
Office of Ecology and Environmental Conservation, EE

FROM: Douglas Le Comte
Douglas Le Comte
Special Projects

SUBJECT: EDS Review of DEIS 7606.36 (Cooper Lake and Channels, Texas)

The EDS has reviewed the subject DEIS and offers the following comments:

The impact statement would be enhanced if a description of flood-producing weather systems were included. Knowledge of the space and time scales of such storms would facilitate assessment of alternatives to the proposed action, especially the applicability of flood warning and evacuation measures.

Climatological information is available from the National Climatic Center, Asheville, North Carolina 28801.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md 20852

C52/JLR

AUG 2 1976

JUL 29 1976

TO: Dr. William Aron
Director
Office of Ecology and Environmental Conservation

FROM: for Dr. Gordon Lill Allen L. Powell
Deputy Director
National Ocean Survey

SUBJECT: DEIS #7606.36 - Cooper Lake and Channels, Texas

The subject statement has been reviewed within the areas of NOS responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

The following comment is offered for your consideration.

Geodetic control survey monuments may be located within the proposed project area. If there is any planned activity which will disturb or destroy these monuments, NOS requires not less than 90 days notification in advance of such activity in order to plan for their relocation. NOS recommends that funding for this project includes the cost of any relocation required for NOS monuments.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md 20852

C52/JLR

JUN 23 1976

Lt. Col. L. A. Hubert, Jr.
Acting District Engineer
New Orleans District
Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Hubert:

This will acknowledge receipt of your letter dated 10 June 1976, LMNPD-RE, and the draft environmental statement for the authorized project, Cooper Lake and Channels, Texas.

Our comments on this DEIS will be included in the reply you will *receive from Dr. Sidney R. Galler, Deputy* Assistant Secretary for Environmental Affairs of the Department of Commerce.

Sincerely,

for Gordon Lill, Deputy
Allen L. Powell
Rear Admiral, NOAA
Director
National Ocean Survey

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

August 16, 1976

OFFICE OF THE REGIONAL ADMINISTRATOR

Colonel Early J. Rush, III
District Engineer
New Orleans District
U. S. Army Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Re: D-COE-G36049-TX

Dear Colonel Rush:

We have reviewed the Draft Environmental Impact Statement, Cooper Lake and Channels, Texas. The recommended plan calls for the construction of a multi-purpose reservoir and channel and levees to provide protection against the 30-year flood in the Sulphur River Basin in northeast Texas. Levee construction and channel work upstream of the proposed Cooper reservoir is 100 percent complete, and work below the reservoir is approximately 50 percent complete. The following elements are proposed to be constructed: a multi-purpose reservoir with dam and spillway on the South Sulphur River at mile 23.2; excavation of the spillway outflow channel and realignment of approximately 35 miles of portions of the South Sulphur and Sulphur Rivers; and enlargement and/or extension of existing levees from the damsite to slightly above the confluence of Cuthand Creek and the Sulphur River.

Generally, the statement discusses the impacts which could be associated with project implementation; however, we offer the following comments for your consideration in developing the Final Environmental Impact Statement:

1. Stream channelization typically results in a loss in diversity of aquatic habitat with concomitant loss of associated biota, decreases in the waste assimilative capacity of the stream, and alteration of the riparian ecosystem through construction associated habitat destruction. These impacts are generally severe and of a long-term nature.

Project associated channelization is to provide 30-year flood protection to approximately 10,000 acres. Apparently, this level of protection will only be realized after erosion of the pilot channel has occurred. An estimated 8,000 acre feet of sediment is expected to be discharged into Lake Wright Patman until channel stabilization occurs.

However, past channel work in the area has indicated that the banks may not stabilize after channelization, resulting in further erosion and water quality degradation. Therefore, we believe that the expected 8,000 acre-feet of sediment to be deposited in Wright Patman Reservoir after erosion of the pilot channel may be a conservative estimate. The impacts of erosion and sedimentation on water quality may outweigh the expected flood control benefits provided by this aspect of the proposed project. Therefore, reconsideration of flood control alternatives seem to be in order.

2. On page I-11 it is stated, "approximately 35 miles of realined channel are required below Cooper dam." On page I-12 it is indicated that excess excavated material would be disposed of in uncompacted disposal areas. The possible effects on water quality from this disposal of material should be discussed in the final statement. Possible erosion control measures and revegetation should be discussed also.

3. In Table II-8, the lead and cadmium levels are reported as being less than 0.200 and less than 0.05 mg/l, respectively. It appears that the detection limits in the measurement of these parameters are above EPA's criteria of 0.05 mg/l for lead and 0.01 mg/l for cadmium. Mercury is shown in Table II-8 as not being detected in the water sample. The final statement should include the detection limits for mercury. Before an evaluation of expected water quality can be made with respect to lead, cadmium, and mercury, data reflecting actual concentrations of these parameters are needed. These data should allow a comparison with applicable criteria, requiring that analytical procedures used have detection limits below applicable criteria. If the concentrations of these pollutants exceed the applicable criteria for water supplies, the source of these pollutants and the possible effects they may have on the suitability of this water for use as a source of raw water for public water supplies should be discussed.

4. The statement indicates that seven sites are designated as recreational and wildlife areas. More information is needed in the final statement concerning the recreational facilities to be provided. For example, the source of water supplies and the disposal of solid waste should be discussed. The treatment of sanitary wastes should also be described, including the type and capacity of the treatment system, the quality of the effluent (if any), and the anticipated volume of wastes to be treated. Also, the possible impacts of increased vehicular traffic on the area's air quality should be considered.

These comments classify your Draft Environmental Impact Statement as ER-2. Specifically, we have environmental reservations regarding the channelization of the stream segment between Cooper Lake and Lake Wright Patman. We are ba ng this determination upon the potential long-term

degradation of water quality which could result from project induced increases in erosion, sedimentation and turbidity. Our Agency recognizes the need for the water supply which will be provided by Cooper Lake, and must point out that we have no objections to this portion of the project. We are also requesting that additional information on water quality be provided in order to evaluate more fully the environmental impacts of the proposed project. The classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We appreciate the opportunity to review the Draft Environmental Impact Statement. Please send us two copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

John C White

John C. White
Regional Administrator

Enclosure

ENVIRONMENTAL IMPACT OF THE ACTION

LO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

ADEQUACY OF THE IMPACT STATEMENT

Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

United States Department of the Interior
OFFICE OF THE SECRETARY
SOUTHWEST REGION
Room 4030, 517 Gold Avenue SW.
Albuquerque, New Mexico 87102

August 17, 1976

ER 76/588

District Engineer
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

As requested in your June 10, 1976, letter to the Assistant Secretary, Program Policy, we have reviewed the draft environmental impact statement for the proposed Cooper Lake and Channels Project for its effects on outdoor recreation, geology, hydrology, fish and wildlife resources, mineral resources, water resources, and national parks, landmarks and historic areas.

We offer the following comments for your consideration:

General Comments

The Cooper Lake and Channels Project is a part of water resource development in the northeastern part of Texas. The project will particularly affect water quality, stream modification and control, and the ecological relations of the bottomlands and nearby uplands in the project area. There will also be economic and social effects. The environmental statement is inadequate in its presentation of project description and environmental impacts pertaining to the interrelated Cooper Lake, Wright Patman Lake and Sulphur River channels project.

Known mineral resources of the project and environs include petroleum, natural gas, lignite, sand and gravel, stone and clays. The statement (p. II-17) recognizes the existence of mineral resources in the area but does not describe the effect of the project on such resources.

Specific Comments

SECTION 2--ENVIRONMENTAL SETTING WITHOUT THE PROJECT

Page II-2, (c), last sentence - It should be indicated that the artifical character of previously dredged streams in the project area is esthetically inferior to unalerted stream segments which still retain their natural stream cover.

Page II-55, (5) - A table depicting the median monthly streamflow under pre-construction conditions, particularly at the Cooper Lake damsite, would be helpful in understanding the comparison of with and without project conditions.

Page II-65, d. - The American alligator is known to inhabit the Sulphur River Basin. In addition to the remnant native population, the Arkansas Game and Fish Commission released approximately 150 alligators at the Sulphur River Wildlife Management Area in Miller County, Arkansas, during 1971, 1972, and 1973, as a part of the Arkansas Game and Fish Commission endangered species management program.

Page II-71, (2) - The incompleteness of proposed project channelization makes a comparison of fishery resources with and without channelization invalid. The comparison of channelized and unchannelized reaches presented here is taken from partial channelization accomplished 15 years ago and overlooks the beneficial effects of the unchannelized stream segments in retarding streamflow, maintaining higher surface water and ground water elevations, and reducing silt and sediment loads in previously channelized portions above or below natural stream portions. It also omits the effects of regulated streamflow below the dam following construction. The most accurate description of fish compositions and nabitat conditions following channelization is best illustrated in the description of North Sulphur River and Cuthand Creek, where channelization is virtually complete.

Page II-71, (4) - For purposes of comparison, the year in which channelization was conducted in North Sulphur River and Cuthand Creek should be cited.

Page II-79, (2) - The comparison of deer population and harvest data compiled by Alexander, 1972, and others is confusing. Supporting information regarding the size, location, and physical differences of the study areas should be presented.

Page II-82, b. - The type of "recreationists" which do not prefer the river for recreation should be identified. It is our opinion that sport fishermen, who comprise a high percent of the total users, have historically preferred stream fishing.

Page II-111, (2) - The final environmental statement should contain evidence of contact with the State Historic Preservation Officer and include his comments concerning the effect of the undertaking upon any cultural properties in the process of nomination to the National

Register of Historic Places. He is Mr. Truett Latimer, Executive Director, Texas Historical Commission, P.O. Box 12276, Capitol Station, Austin, Texas 78711.

Page II-134, 5. - It is not clear why attitudes of "residents" are discussed in section 4 on impacts while attitudes of "leaders" are discussed in section 2 on pages II-128 through 131 and summarized as a display in table II-45.

Page II-137, 2.11, (1) - The beneficiary of the additional 120,000 acre-feet of water supply allocated to Wright Patman Lake should be identified as the International Paper Company, not the city of Texarkana, Texas. The use of the reservoir water by the paper company was granted by the Corps in July 1968. In the Corps of Engineers' letter to the U.S. Fish and Wildlife Service, dated July 3, 1968, it is stated:

> "The city of Texarkana, Texas, has requested that the U.S. Army Corps of Engineers provide from the Texarkana Reservoir on an interim basis until Contract No. DACW29-68-A-0103 becomes effective, a water supply of 84 m.g.d. This water would be for the use of the International Paper Company - 28 m.g.d. for process purposes and 56 m.g.d. for water quality control. The U.S. Army Corps of Engineers has determined that, by revision of the current operating rule curve procedure, the 84 m.g.d. requested by the city of Texarkana, Texas, can be furnished."

Page II-139, b. - Based upon a Texas Water Development Board preliminary plan for "Proposed Water Resources Development in the Sulphur River Basin," dated 19 June 1966, two additional reservoirs Sulphur Bluff I and Naples, and enlargement of Lake Texarkana (Wright Patman Lake) will be required by the year 2020 to satisfy water supply needs inside and outside the basin. These projects, if initiated, would have a tremendous impact on the natural resources of the project area and should therefore be addressed.

SECTION 4--THE PROBABLE IMPACTS OF THE PROPOSED ACTION ON THE ENVIRONMENT

Page IV-2 - An explanation regarding the frequency and duration of zero flow periods would enable the reader to analyze the benefits derived from a minimum release of 5 c.f.s. The downstream flows from the reservoir perhaps will not result in enhancement of overall stream conditions for fish populations. However, the minimum flow release of 5 c.f.s. should have beneficial impacts compared to the sometimes existing no-flow conditions. This should be stated.

Page IV-2, 3. - Data to support the statement that long-term water quality will be improved in Wright Patman Lake due to sediment removal at Cooper Lake should be provided. We believe that channel and levee construction and project-induced land clearing will result in increased sediment and pesticide loads in the Sulphur River and Wright Patman Lake. A with and without project analysis of the total sediment deposited in Wright Patman Lake would be helpful in understanding the impacts and should be provided in the final environmental statement.

Page IV-5, b. - Impacts on vertebrate and invertebrate forms within rights-of-way for the reservoir are discussed; however, the impact of human disturbance on the 3,300-acre area to be developed for recreation, 6,275 acres for other project purposes, and development of adjacent private land as a result of the project is not addressed.

Page IV-6 - The statement that, "...a variety of seed producing annual grasses may invade the moist shoreline," is speculation. A dependable source of seed for waterfowl is not common on unmanaged areas at this latitude.

The American alligator, known to occur at the Arkansas Game and Fish Commission's Sulphur River Wildlife Management Area, could be affected by further modification of downstream release below Wright Patman Lake. Extended periods of minimal flow (10 c.f.s.) would be particularly detrimental to this species. Contrary to the statement, "The project will not adversely affect any known critical habitat for threatened or endangered species," the Governor of Arkansas, in a letter dated October 20, 1975, requested the Secretary of the Interior to declare the Sulphur River Wildlife Management Area as critical habitat for the American alligator. Although final action has not been taken on this request, the EIS should indicate that the project could import critical habitat if the state recommendation is fulfilled

Page IV-6 and IV-15 - The fact that there will not be an adverse effect does not constitute a beneficial effect due to the project. Perhaps this type of information would be appropriate in the opening paragraph on the Nature of Impacts rather than in either beneficial or adverse impacts.

Page IV-7, (c) - The "most similar project" concept used to predict initial and total day-use at Cooper Lake (Table IV-1) takes into account several factors mentioned on Page IV-9. However, another factor which would have a significant impact on surrounding facilities would be the loss of man-days and related income due to the redistribution of recreationists as a result of Cooper Lake construction. The ability of our modern society to travel 50 or more miles to a new reservoir where fishing and water contact recreation facilities exist makes the opportunity for "shifting" recreationists a very real consideration which should be a part of the day-use analysis.

Page IV-10, Table IV-2 - In light of suggested dollar values assigned to various types of hunting and fishing by the Water Resources Council's, "Principles and Standards for Planning Water and Related Land Resources," the dollar values assigned to man-days of hunting and fishing seems low.

Pages IV-11 and IV-16 - On page II-123 the statement is made, "These respondents are not necessarily representative of the population since the sampling techniques used were not entirely random." The conclusion that the project is widely supported may be faulty if biased methods were used to select interviewers.

Page IV-14 - We agree the reduction in overbank flooding of oxbow cutoffs should reduce the chance for contamination from agricultural chemicals in the river. It should be pointed out, however, that these isolated bodies of water, particularly near agricultural croplands, are benefitted by the "flushing" effect of periodic overflow, which reduces the accumulation of agricultural chemicals in runoff from adjacent cleared land.

Page IV-14, (3)a. - The method of controlling woody growth on levees should be identified. Mechanical controls are preferred over chemical sprays to minimize fish and wildlife resource damages.

Page IV-15, (2) - Due to the projected loss of 7,920 acres of bottom-land hardwoods and 1,800 acres of semiwooded lands expected as a result of the proposed levee and channel features, the Fish and Wildlife Service disagrees with the statement that, "... the losses in woodland acreage may be compensated for by an increase in edge."

Page IV-15, (3) - The opinion that several wildlife species, including opossum, raccoon, fox, squirrel and white-tailed deer, will be benefitted by induced clearing and increased agriculture is unjustified. The 8,400 acres of bottomland hardwoods and semiwooded native pastures affected by induced clearing support a potential carrying capacity for these species and many other game and non-game mammals which far exceeds that of cropland and improved pasture.

Page IV-16, (c) - The hunting and fishing benefits derived from oxbow cutoffs seem to be overly high in view of the statement on Page IV-36, first incomplete paragraph that, "... the benefits to be derived from these lakes were not sufficient to justify the costs of constructing the access routes." It would seem that if 11,737 man-days of consumptive recreation valued at $18,000 and an annual harvest of 12,355 pounds of commercial fish values at $1,900 could be obtained without public access, the inclusion of access would create a significant increase in recreation man-days and commercial fish harvests.

Page IV-19, a. - The use of the word "only" is inappropriate in view of the 80 percent loss of woodlands. A discussion of the impact of this timber loss on the local timber industry, and an analysis of the project construction or induced losses in comparison with the total basin bottomland forest should be provided.

Page IV-19, 3 - It should be mentioned that private, residential, and recreational development outside the take line boundary would also contribute to flora alterations within the basin.

Page IV-21, (4) - It is our view that the loss of bottom land hardwoods and semi-wooded native pastures will have a significantly greater impact on white-tailed deer than the loss of agricultural crops, which provides a seasonal food source to supplement the deer's natural diet.

Page IV-21, 4. Endangered and threatened species - Lack of information concerning the effects of reallocation of flood storage on downstream releases below Wright Patman Lake causes us to seriously question the statement, "None of the endangered fauna will be adversely affected by the reservoir." Further reduction in overall reservoir releases and increased periods of minimum flow could adversely affect the American alligator in Arkansas. Based upon discharge data published by the Corps of Engineers since 1959 and available through 1973, minimum reservoir releases of 10 c.f.s. have been maintained. The average number of recorded minimum flow days is 70. A maximum number of minimum flow days (a total of 219) occurred in 1972 and the minimum number (no days) occurred in 1968.

Pages IV-21-25 and Pages IV-31-32 - Pertinent background information depicting conditions and time periods upon which potential losses are based would be helpful in evaluating effects of the project on consumptive and nonconsumptive use. It is our belief that potential man-day losses described in this section are unrealistically low in view of the high quality of fish and wildlife habitats affected. A more liberal monetary value assigned to the specific types of hunting and fishing should also be considered to bring these values in line with suggested values contained in the Water Resources Council's "Principles and Standards for Planning Water and Related Land Resources."

Page IV-27, (2) - The duration of erosion and high sediment loads resulting from channel construction and natural stream cutting should be discussed. Based upon the obvious effects of channel widening and erosion resulting from channelization of North Sulphur River, the possibility of long-term or conditional erosion and sediment problems should be pointed out in the statement. Due to the construction of a 10-foot-wide channel on the lower 35 miles of North Sulphur River several years ago, the Soil Conservation Service in recent years has initiated a Resource Conservation and Development project program in the drainage area to control further widening and erosion of the North Sulphur River which at this time is approximately 300 feet wide. We

also believe the increased cost of water treatment by Wright Patman Lake water supply users should be more specific. A sentence in this paragraph reads, "Consequently, an increase in the cost of drinking water treatment could be experienced for users from Wright Patman Lake." A paragraph on water quality on page IV-2 reads, "This may decrease the cost of water treatment for users of water from Wright Patman Lake." Each statement is made in reference to sediments, and each statement is correct in context. The two statements do illustrate the problem of keeping the many phases of the total statement in context.

Page IV-35, (b) - The 6,000 acres purchased for project purposes, would not provide adequate mitigation for fish and wildlife habitat losses incurred by the project reservoir, levee and channel features. Furthermore, based upon past experience, the reservoir operation plan would have priority over any management plans recommended or initiated by the Texas Parks and Wildlife Department, thereby restricting the potential for wildlife management.

Page IV-36 - The exclusion of public access at oxbow lakes created by channel alignment may warrant recommendation changes to include as an alternative to developing oxbow lakes, the recommendation that natural channels serve as the primary system for conveying normal flows. The aligned channel could, therefore, convey flood releases and runoff exceeding normal stream flow elevations. This alternative could provide continued access to boats carrying sport and commercial fishermen, waterfowl hunters, and nonconsumptive recreationists.

There is a lack of meaningful information concerning Wright Patman Lake within the draft statement. We request that the final statement discuss the enlargement of Wright Patman Lake for water supply (120,000 acre-feet), and background information concerning the National Pollutant Discharge Elimination System permit for the International Paper Company discharge below Wright Patman Lake. Furthermore, the concerns of Federal, State and private agencies and groups regarding the fish and wildlife impact of these alterations should be presented in the form of pertinent correspondence containing comments from all agencies concerned. Previous comments by the Fish and Wildlife Service point out that due to the reduction of downstream releases numerous fish kills have occurred and inadequate releases have resulted in substantial detriment to navigation for small boats in the Sulphur River Wildlife Management area, the primary means of access to and through the State-owned area.

SECTION 5--ANY ADVERSE PROBABLE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Page V-2 - This paragraph could be restated. Air and noise factors do not usually deteriorate water quality.

Plate II-2 - The map indicates that the reservoir will not conflict with known oil or gas fields; however, levees 3RS and 4RS might overlap an unnamed oil field in Franklin and Titus Counties. Also, the document indicates that most oil in the region is produced from fault traps (pp. II-2, II-15, II-17). Because several faults occur within the project area, we suggest that the final draft of the EIS discuss more fully the possibility of new oil and gas discoveries in the area and indicate Corps of Engineers policies toward such exploration and production from within the project site.

We believe that the lignite and clays of the area are uneconomic and that the project will not significantly alter the availability of sand and gravel or stone. Pipelines in the area are noted, and the document states that they will be relocated.

We agree that faults in the area apparently are inactive, having shown no recent movement. Still, we believe that the final version of the document should discuss in more detail possible effects of the faults on the reservoir.

Sincerely yours,

Willard Lewis

Willard Lewis
Special Assistant to the Secretary

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

IN REPLY REFER TO

SEP 1 1976

Colonel Early J. Rush III
District Engineer, Corps of Engineers
Department of the Army
P.O. Box 60267
New Orleans, Louisiana 70160

Reference: LMNPD-RE

Dear Colonel Rush:

This is in reply to the letter of June 10, 1976, addressed to the Commission's Acting Advisor on Environmental Quality, requesting comments of the Federal Power Commission on the draft environmental statement for the authorized project, Cooper Lake and Channels, Sulphur River Basin, Texas.

The Cooper Lake and Channels project would consist of a multipurpose reservoir, levees, and an improved channel to provide flood control, water supply, and recreation. Portions of the project have been completed in accordance with the authorization.

These comments of the Federal Power Commission's Bureau of Power are made in accordance with the National Environmental Policy Act of 1969 and the August 1, 1973, Guidelines of the Council on Environmental Quality. Our principal concern with projects affecting land and water resources is the possible effect of such projects on bulk electric power facilities, including potential hydroelectric developments, and on natural gas pipeline facilities.

The Federal Power Commission has previously considered the hydroelectric power potential of the Cooper Lake project. In its letter of September 27, 1968, to the Secretary of the Army, the Commission concluded that the proposed Cooper project would not provide opportunity for the economical development of hydroelectric power.

The draft statement indicates that relocations would be required for a number of electric power transmission lines, electric power distribution lines, and natural gas pipelines. The relocation of these facilities should

be conducted in such a manner as to minimize any disruption of service.

The opportunity to comment on this environmental statement is appreciated.

Very truly yours,

W. Ridgway
Chief, Bureau of Power

State of Louisiana
DEPARTMENT OF PUBLIC WORKS
P. O. BOX 44155, CAPITOL STATION
BATON ROUGE, LOUISIANA 70804

ROY AGUILLARD
DIRECTOR

BOARD OF PUBLIC WORKS
GEORGE CHANEY, CHAIRMAN
EMMETT A. EYMARD
P. P. VERRETT, SR.
RICHARD P. GIBSON
ROLAND CARTER

June 29, 1976

Colonel Early J. Rush, III, District Engineer
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Re: LMNPD-RE

Dear Colonel Rush:

This department has reviewed the draft environmental statement for the authorized project, Cooper Lake and Channels, Texas. It appears that the environmental appraisals and concerns for the project are well documented and presented. We have no comments to submit concerning the report.

We wish to express our appreciation for the opportunity to review and comment on this environmental impact statement.

Sincerely,

ROY AGUILLARD
Director

GRD/pal

STATE OF ARKANSAS
DEPARTMENT OF LOCAL SERVICES
SUITE 900 • FIRST NATIONAL BUILDING
LITTLE ROCK 72201

DAVID PRYOR
GOVERNOR

RONALD R. COPELAND
DIRECTOR

August 30, 1976

Lieutenant Colonel L. A. Hubert, Jr.
New Orleans District, Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Re: Cooper Lake and Channels

Dear Colonel Hubert:

The State Planning and Development Clearinghouse is in receipt of the above cited Environmental Impact Statment. Enclosed for your use and information are the comments of the responding state agencies. There were no adverse effects identified.

The State Clearinghouse is responsible for coordinating the review and comment of Environmental Impact Statement in cooperation with the Chairman of the Technical Review Committee. Copies of the Environmental Impact Statement should be sent to this office for distribution.

If we can be of further assistance, please don't hesitate to call on us.

Sincerely,

Fred Kleihauer
Director, State Clearinghouse

FK:mh
Encs:

ARKANSAS GAME AND FISH COMMISSION
August 2, 1976

MEMORANDUM TO: John P. Saxton, Chairman
Technical Review Committee

FROM: Richard W. Broach, Member
Technical Review Committee

I am in receipt of a June 18, 1976 memorandum and the attached Draft Environmental Impact Statement concerning Cooper Lake and Channels, Texas.

I would reiterate earlier recommendations of the U. S. Fish and Wildlife Service as concurred in by the Arkansas Game and Fish Commission for minimum downstream flows from Lake Texarkana in view of the importance of the Sulphur River Wildlife Management Area and integral waterways to the state's resident wildlife and fisheries resources, to migratory waterfowl and to the American alligator, an endangered species.

As this project is located in Texas, we will look to the U.S. Fish and Wildlife Service to assume a lead role in the coordination and comment processes.

RWB:ac

cc: U. S. Fish & Wildlife Service, Vicksburg

RECEIVED
AUG 4 1976
SOIL AND WATER
CONSERVATION COMMISSION

SAXTON	
YOUNG	
[illegible]	
[illegible]	
[illegible]	
[illegible]	
[illegible]	
STEPHENS	
[illegible]	
[illegible]	
[illegible]	
[illegible]	
BURK	
[illegible]	
COUCH	

ARKANSAS HISTORIC
PRESERVATION PROGRAM
FIRST STATE CAPITOL • 300 WEST MARKHAM • LITTLE ROCK, ARKANSAS 72201

July 21, 1976

Mr. John P. Saxton, Chairman
Technical Review Committee
1200 W. Park Drive
Room 308
Little Rock, Ar. 72204

Re: Draft Environmental Statement
Cooper Lake & Channels, Texas

Dear Mr. Saxton:

This letter is written in response to your inquiry of June 18, 1976, regarding properties of architectural and historical significance in the area of the proposed Cooper Lake & Channels project.

The professional staff of the Arkansas Historic Preservation Program has reviewed the available material which pertains to the area in question. The staff of the Historic Preservation Program has reported that the proposed Cooper Lake & Channels project will not affect any property of architectural or historical significance.

Archeological clearance from our program must come through Ms. Hester Davis, State Archeologist, University of Arkansas, Fayetteville, Ark. 72201.

Sincerely,

Anne Bartley

Ann Bartley
State Historic Preservation Officer

AB:

cc: Hester Davis

RECEIVED
AUG 3 1976
SOIL AND WATER
CONSERVATION COMMISSION

A DIVISION OF THE DEPARTMENT OF ARKANSAS NATURAL & CULTURAL HERITAGE

OFFICE OF THE GOVERNOR
STATE CAPITOL
AUSTIN, TEXAS 78711

DOLPH BRISCOE
GOVERNOR

December 14, 1976

Colonel Early J. Rush III
District Engineer, New Orleans District
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Rush:

The draft Environmental Impact Statement for Cooper Lake and Channels, Texas, has been reviewed by my Budget and Planning Office and by responsible agencies of the State of Texas.

The findings of the draft document confirm and complement the technical feasibility determination made by the Texas Water Rights Commission in the issuance of water rights permits for this project. The Texas Water Development Board strongly supports this project and urges that it be developed as soon as possible to meet the future water needs of this important region of the State. The Board has stated that the overall benefits from the implementation of this project will far outweigh any possible adverse effects.

As Governor of the State of Texas, I am committed to the effective development of the water resources of the river basins and watersheds of this State. The Texas comprehensive program for water resource development is designed to meet anticipated needs, and Cooper Lake is a designated project in the Short Range Plan of this program. Cooper Lake is a multi-purpose project that will provide not only essential water resources for the Sulphur River and the North Texas Municipal Water Districts and the City of Irving, but it will also reduce the threat of flooding in the Sulphur River Basin.

This important water resource development project has the full approval of the State of Texas. It is my position as Governor and it is the position of the State of Texas that this urgently needed water supply and flood control project should be carried to completion at the earliest possible date.

Sincerely,

Dolph Briscoe
Governor of Texas

DB/gt

ENVIRONMENTAL
DEFENSE
FUND

162 OLD TOWN ROAD, EAST SETAUKET, N.Y. 11733/516 751-5191

June 29, 1976

Lt. Colonel L.A. Hubert, Jr.
Acting District Engineer
Department of the Army
New Orleans District
Corps of Engineers
P O Box 60267
New Orleans, Louisiana 70160

RE: LMNPD-RE-Draft EIS on the Cooper Lake and Channels, Texas Project

Dear Lt. Col. Hubert:

Although we could comment in detail on the draft environmental statement for the Cooper Lake and Channels, Texas project, we shall limit ourselves to three comments.

First, the draft EIS discloses that at the very least 2,560 acres of bottomland hardwoods will be cleared and destroyed as a result of the project. We anticipate that, in fact, as a result of construction, maintenance and operation of the project and secondary hydrologic impacts, thousands of other acres of bottomland hardwoods will be adversely affected. This destruction of bottomland hardwood is contrary not only to substantive policies of NEPA but to Corps wetland policies as enunciated in 33 U.S.C. §209.145(e)(3), issued pursuant to 33 U.S.C. §1344.

This is only one of numerous Corps of Engineers civil works projects in the southeast, the delta states and southwest of the United States which are systematically destroying, directly or through secondary impacts, hundreds of thousands of acres of bottomland hardwoods. Not one of these impact statements addresses the cumulative effect of all of these Corps of Engineers projects on bottomland hardwoods. Until the Corps of Engineers prepares a program impact statement evaluating the impact of its various programs on wetlands throughout the United States, each individual impact statement must address and evaluate the cumulative effects on bottomland hardwoods and other forms of wetlands of the individual project in question and other projects elsewhere. This kind of cumulative impact analysis is required by 33 U.S.C. §209.145(e)(3)(iii). It is also required by NEPA. The bottomland hardwood and wetland renewable resource base of the southern part of the country is gradually being destroyed by a variety of human activities most of which are under the direct or permit control of the Corps of Engineers.

OFFICES IN EAST SETAUKET, NY (MAIN OFFICE), NEW YORK CITY (PROGRAM SUPPORT OFFICE), WASHINGTON, DC, BERKELEY, CALIF., DENVER, COL.

Second, the draft EIS indicates that at least 78 miles of natural river will be realigned and channelized. Channelization of rivers inevitably results in the destruction of water based habitat and also the degradation of water quality. This has been demonstrated in any number of studies. Inevitably, channelization increases turbidity, erosion and downstream siltation. Furthermore, secondary impacts from changing uses of the water resources in question inevitably result in the degradation and pollution of affected water resources and water quality. These water quality impacts should be assessed and evaluated in view of the standards developed in the 1972 Federal Water Pollution Control Act Amendments. Specifically, Section 313 of that Act, 33 U.S.C. §1323 provides that federal installations must "comply with federal, state, interstate and local requirements respecting control and abatement of pollution to the same extent that any person is subject to such requirements." Federal, state and local pollution control requirements are set forth in state water quality standards developed under 33 U.S.C. §1313(c), EPA Interim Drinking Water Standards developed under the *Safe Drinking Water Act, basin plans* developed under 33 U.S.C. §1313(e) and areawide waste treatment management plans being prepared under 33 U.S.C. §1288. Thus, the EIS should evaluate the water resource and water quality impacts of the project in light of these standards, policies and plans.

Third, the project is designed to provide 30 year flood protection to certain areas. This objective of the project does not appear to be compatible with the purposes of the 1973 Flood Disaster Protection Act and regulations issued thereunder. A full discussion of the impact of this project on the participation of any communities in the relevant area in the Federal Flood Insurance Program and implementation of reasonable local land use ordinances designed to implement the policies of the Flood Disaster Protection Act should be fully discussed and evaluated.

Yours very truly,

James T.B. Tripp

James T.B. Tripp
Counsel

July 29, 1976
P. O. Box 145
Blanchard, Louisiana 71009

Early J. Rush,III, Colonel, CE
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Colonel Rush:

After having carefully evaluated the Draft Environmental Impact Statement for the Cooper Lake and Channels, Texas, project, the Conservation Committee of the Bayou Chapter (Ozark Society) wishes to make known our objections to this proposal. This project would accomplish three objectives: a permanent water supply for the people of this area, flood control, and recreation. Unfortunately, to adopt this proposal calling for a reservoir and channelization of the Sulphur River would result in needless destruction of valuable wildlife habitat. Each year thousands upon thousands of valuable acres are lost to projects such as this one. It is time to begin carefully weighing the destruction of habitat with any possible accomplishments.

The DEIS does not give any evidence of the need for more areas of recreation in northeast Texas. Since the Wright Patman Lake is so close we would have to question the actual (not potential) use that any additional reservoir in the area would receive. Furthermore, the unloading of large amounts of sediment in Wright Patman

Lake would surely decrease its desirability as a recreation facility, as well as its use in water supply.

As stated in the DEIS, public access to the river prevents its use in recreation now. This problem could be easily and cheaply solved by purchasing a few tracts accessible to the public and designating them for recreational uses.

Another worthwhile objective of the project listed in the DEIS is flood control. However, we cannot justify flooding 19000 acres in order to protect 12900 acres. Furthermore, periodic flooding is important in furnishing nutrients to the soil. Flooding is just one of nature's tools that is essential for the continued productivity of the soil. Farmers of this area, with the proper guidance, could use the enrichment of the soil by flooding to their advantage.

The DEIS also states that the channelization of the Sulphur River will have a diastrous impact on the stream ecosystem. The increased agricultural activity will result in increased levels of insecticides, herbicides, and fertilizers in the aquatic ecosystem. Increased erosion resulting from clearing the land will also occur. The combined effect of more siltation, insecticides, herbicides, etc. will surely result in more deleterious effects on Lake Wright Patman. Adopting this proposal would be grossly unfair to those people dependent on Lake Wright Patman for their water supply.

The only possible advantage to this project would be the establishment of a permanent water supply. We suggest thatthe need of such a water supply be quantified, and then alternative

methods taken to meet this need.

In summary, The Conservation Committee of the Bayou Chapter (Ozark Society) is opposed to the Cooper Lake and Channels, Texas, project. The need for the reservoir and channelization of the Sulphur River has not been quantified, and as we have pointed out, the disadvantages of this proposal far outweigh any advantages it may have. Furthermore, although this proposal may solve some of the problems of the residents of this area, it will create a multitude of problems for the residents dependent of Lake Wright Patman for their water supply. Therefore, we request that a suitable alternative be considered that would not result in a structural modification of the Sulphur River.

Respectfully,

Larry R. Raymond

Larry R. Raymond, Member
Conservation Committee of
the Bayou Chapter
(Ozark Society)

TEXAS COMMITTEE ON NATURAL RESOURCES
4144 COCHRAN CHAPEL ROAD
DALLAS, TEXAS 75209
(214) 352-8370

COMMENTS BY TEXAS COMMITTEE ON NATURAL RESOURCES CONCERNING THE DRAFT ENVIRONMENTAL STATEMENT, COOPER LAKE AND CHANNELS, TEXAS

Omissions from Statement

1. System-wide impacts (except that the statement does touch lightly upon the siltation which the channel would cause in Lake Wright Patman).
2. Harmful effects on the estuary at the Gulf of Mexico.
3. Net energy loss, including from construction and maintenance of the dam and channel.
4. Effect of the channel in lowering the water table.
5. Deprivation of the floodplain soil from periodic enrichment which occurs so long as floods continue bringing nutrients.
6. Losses of water through evaporation from the reservoir and the open, unshaded channel.
7. Costs of the projected growth to be caused by damming and channelization, including increased costs of water treatment, sewage and solid waste disposal, air and water pollution control, law enforcement, crime, urban blight, education, public welfare, hospitalization, etc.
8. The alternative of a plan which utilizes more than one of the non-structural floodplain management elements of zoning, acquisition flood warning, agricultural education,etc. in the various stretches of the river at various accesspoints.
9. The alternatives which would manage floods of 100 year frequency rather than merely 30 year frequency.
10. The alternative of a strictly water supply reservoir and no channelization or other flood control structures.
11. The nature and effect of land ownership and habitation patterns.

Inadequacies of Statement

12. The discussion of erosion and siltation fails to cite specific locations, causes and values, and fails to contrast structural and non-structural effects.
13. The statement fails to explain how the loss of 19900 acres of wildlife habitat in the reservoir site would be mitigated by acquiring 1200 acres of periodically inundated lake shore.
14. The statement fails to state what mitigation acquisition is required to offset losses of habitat to be caused by proposed channelization, and to descibe these losses.
15. The statement fails to evaluate the construction costs necessary to offset the sedimentation which the channel would cause in Lake Wright Patman, and to assess the environmental costs of such sedimentation.
16. The statement fails to describe and explain the erosin and siltation damages caused by channels and levees already constructed in the Sulphur River and tributaries and to consider the devastating effects of these structural features.
17. The statement placing the responsibility of levees on local interests fails to consider in this connection the fact,stated on a different page, that the local interests have not maintained adequately the existing levees.
18. The statement fails to quantify the wildlife losses from inundation and channelization.
19. In discussing recreational attractions, the statement fails to confront the question of how many potential users would be attracted away from nearby lakes already constructed or being planned, and what effect this competition would have upon the benefit/cost ratios of those lakes.
20. The statement refers to an Ark-Tex COG study which should be completed in the near future, including land use information for the Cooper Lake area, but reflects no effort to obtain or to report preliminary drafts of that study.
21. The statement refers to an Ark-Tex COG comprehensive open space plan proposing that the Cooper Lake and Channels area be left either a natural or undeveloped state. Yet the statement in no way elaborates nor gives reasons why the Ark-Tex plan is right or wrong.

Inaccuracies of Statement

22. The statement refers to benefits of ox-bow lakes which would be cut off, but fails to show that such ox-bows would silt up and eutrophy in a short time.
23. The project claims recreation benefits from ox-bows but this is impossible because the statement rejects providing public access.
24. The statement says the reservoir would protect 3200 acres of bottomland hardwood forest downstream but fails to state that the rpojected cessation of flooding would actually deprive the forest of nutrients and water and would thereby eventually kill it, rather than protect it.
25. The statement distorts the annual benefits of structural flood control alternatives and showing zero or minimal annual benefits to non-structural, which also reduce flood damages, although in a different way, and which, in other Army Corps projects, have been found to be more cost effective.
26. The statement distorts the purposes of the National Flood Insurance Program and its applicability.
27. While the statement contends that floodplain zoning results in possible relocation, there are, in fact, no houses or buildings in the floodplain, so there are none to relocate.
28. While the statement contends that acquisition of greenbelt land is a matter of local action, the law, on the contrary, provides a mechanism for federal matching funds of at least 80% of such cost.
29. Although the statement contends that the purchase of greenbelt lands would have to be coordinated by the Texas Water Development Board in accordance with the requirements of the existing Texas WaterPlan, the law is that an acquisition program could be accomplished under Articles 1581e-1 and 8280-13, Revised Civil Statutes, without any Texas Water Plan. In any event, the Texas Water Plan is nebulous. If necessary, a greenbelt plan for the Sulphur River could be written into a Texas Water Plan.

30. The statement says than an acquisition plan would require acquisition of 89,200 acres. This is false. Not even a total acquisition of a riverside corridor would necessarily involve 89,200 acres. Moreover, almost any acquisition plan would require purchase of less than the entire streambank. A few public access tracts and park sites would provide excellent recreation potential and would be far cheaper than a total acquisition. The unacquired tracts could be left in private ownership and management, subject to planning against flood prone building projects.

31. The statement says that an adverse effect on non-structural floodplain management would be its failure to prevent flooding. On the contrary, this is a beneficial effect since flooding would discourage the erection of buildings in the floodplain, and thus would prevent future losses of such buildings. Flooding is also beneficial in enriching the soil, saving huge fertilizer costs.

32. The statement claims that under non-structural floodplain management, flood control benefits would be foregone. This is contrary to the basic principles of non-structural floodplain management, which prevents flood losses, and thus has great benefits.

33. The *statement implies* that under No Action approach, the silting resulting from uncompleted channel work upstream 20 years ago would persist. In truth, if the statement discussed the facts, the prior channelization caused several times the erosion and siltation which the Army Corps anticipated. Additional channelization would in reasonable probability have similar results. This damage is not truly a result of No Action, but a result of just the kinds of action which the Army Corps desires to continue.

34. The statement says that No Action would result in no growth. In view of the kind of growth which is often attracted when Army Corps projects so result in growth, the environment and the people of the Sulphur River watershed would be better off with no growth. However, without this project, some growth would occur in any event a sounder more moderate growth. The long-time rise in real estate values is evidence of this.

(3)

THE UNIVERSITY OF TEXAS AT AUSTIN
AUSTIN, TEXAS 78712

Department of Zoology

21 June 1976

Col. L. A. Hubert, Jr.
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Col. Hubert:

I have received the draft environmental statement for Cooper Lake and Channels -LMNPD-RE. I am quite disappointed at the extensive inconsistencies, ommissions and errors. It is regretable that so little substantive material is included. My reading emphasized aquatic biological elements as that is my area of expertise; I would hope that other segments are vastly better than those parts I have examined. On occasion an omission I mention may be covered in other sections but I failed to find crossreferences in discussions germane to aquatic biology.

1) II-67 mentions fish collections (actually only two) made in July 1953 by Dr. Strawn and me. Nowhere in the statement can I find reference to the fact that those were two random collections by two workers during which no undue effort was made to accumulate an extraordinary species list. Only parts of two days were involved - the actual man hours invested was no more than 12 hours. Despite the above, those collections are reported to include 45 fish species, three of which were not taken in any other samples. Certainly, the results of this minor effort by us is in accord with an hypothesis that sampling is incomplete; a circumstance verified by the failure to include *Zygonectes olivaceus* among the fishes in the basin. That list of 45 species in somewhat larger than the 29 reported by Dr. Ingold from channelized (and adjacent segments) regions. Note that a channelized stream will impact an adjacent nonchannelized segment. There is no mention of the differential despite the converse difference in collection numbers (=effort?) - i.e. 17-23 collections vs. 2. I expect that Dr. Ingold invested vastly more man hours than we did. The text implies a level of completion discordant with our two collections.

2) II-74&75 This table only lists relative abundance not abundance. This approach ignores the extensive documentation that absolute abundance decreases when streams are channelized. If the total fish abundance were to decrease by 75% but that of a selected species decreased only 50% there would be an artificial increase in abundance reported by this method. Actual abundance is what II-71 and 76 imply.

All of this discussion fails again to address collection effort. How many collections were made in each stream? In the channelized vs. nonchannelized segments?

Despite its deficiencies this table does include some valuable data that I cannot find discussed (or even mentioned) in the text. Four species were found only in that nonchannelized segment. Four others were common only in that nonchannelized segment. Strangely, the putative impacts of channelization are

listed in appendix C as negligable twice for fish found only in nonchannelized segments and once for a fish found common only in the nonchannelized segment. It is extraordinarily ironic that appendix C implies that a fish not found at all is impacted less than those not found to be common. Is erradication a negligible impact? The text misleads the unwary reader.

3) II-71 states that the North Sulphur River has been partly channelized. I have examined Plates I-1, VI-1, VI-2, VI-3, VI-4, VI-5, VI-6, VI-7, VI-8, VI-9, VI-11, VI-12, VI-13, VI-14, VI-15, VI-16 all of which have legends for existing channelized stream segments but I fail to find the North Sulphur so designated. What parts are channelized?? That information is essential for anyone to determine the impacts of this project.

4) II-84 has a reference to Table II-33 which "lists the lakes within a 100 mile radius of Cooper Lake." I fail to find listed Atoka, Clayton, Murray, Millwood, Gilham, Lukfata, Hugo, and Wister (perhaps 100+ miles distant). I will grant that II-33 is from Texas Parks and Wildlife; they have an excuse for omitting Arkansas and Oklahoma Lakes, does the Corps? If Oklahoma inhabitants are to be included among potential users (IV-8, 9), then Oklahoma reservoirs should be included in the potential use competitors. I also note another completely nonoverlapping list of lakes on II-142. Omission of those lakes from II-84 misleads readers.

5) II-64 Benthic macroinvertebrates refers to plate II-4 but II-5 seems more appropriate. Nowhere in II-64 can I find references to abundance of benthic macroinvertebrates in existing channelized vs. unchannelized segments. Why is that information absent?

6) IV-3 states that the reservoir will stratify but nowhere can I find references to the impact of stratification on biota, the impact of selected releases from different strata on downstream organisms. You may have assumed this last not to be critical as channelization will (or has) undoubtedly reduced the indigenous biota far more than would mismanagement of the outlet works. The design and operations of the outlet works would help to predict biologic impacts.

7) IV-6 suggests that increased water will "enhance available habitat" for the American alligator. This statement typifies the simplistic approach of the draft statement. What type of waters are inhabited by alligators - reservoirs or swamps? Which type will increase in abundance? Similarily, what waters are stream fishes adapted to inhabit?

8) IV-12 states (without documentation) that oxbow cutoffs "are known for their high degree of sport fishery potential." Have you considered references such as Beecher, Hixon, and Hopkins' 1976 report of reduced diversity in oxbows contrasted with the present river? A gain in one kind of fish may entail a loss in another.

9) Appendix C. This appendix is totally inadequate and misleading. It is so bad that I deferred reading any other section when I read it. I have not found any reference to the Appendix in those sections I have read. For example V-1 states that "In excess of 50 percent of the fish species presently occurring in the natural river may be reduced or eliminated from that reach of the river that will be inundated by the lake," and channelization will have similar results on the fauna. Appendix C has 45-48% of the fishes receiving "negligible" impact. By inference then all impacts listed in Appendix C are negative. This is

C7

clearly in error.

The most critical and pervasive deficiency in Appendix C is that impacts are not listed as positive or negative. No reader is able to determine what is the projected change - plus or minus. Is an extensive impact an extensive increase or decrease? This applies to all parts of Appendix C.

There is a listing "general habitat" with different key categories for Invertebrates, Fishes, Herptiles, Birds and for Mammals. Some categories are nonsense. Where in the project area will one find Marine, Lower by 15-30 ppt, offshore more than 10 fathoms, etc.? Never are these short listings defined. For example how does a stream differ from a large creek, etc., etc. Lakes and reservoirs are considered to be the same things. They are not.

The classification of "important fishes" is unrealistic. *Centrarchus macropterus* and *Lepomis megalotis* are listed as sport fishes but *Lepomis auritus* is not. *Minytrema melanops* and *Dorosoma petenense* are listed as commercial fishes but *Carpiodes carpio* is not. I wonder whether you have any estimate on the gross value of *Notropis lutrensis*, *Pimephales promelas* and *Semotilus atromaculatus* sales. I would guess the total would be near $1,000,000 annually in the United States.

You list *Etheostoma artesiae* as uncommon but do not list it as having a habitat. You list *Pimephales notatus* as living in two habitats but "may not occur in the state." The "negligible" impact of the project on both species may be realistic in as much as they are both undoubtedly absent. The U. S. listing for several other species implies absence in Texas; the range listing for *Dorosoma petenense* is clearly suspect on nomenclatural grounds alone. Similarly, the negligible impacts listed for *Alosa chrysochloris* and *Anguilla rostrata* seem reasonable as it is likely that the dam impounding Wright Patman (=Texarkana) Lake had exterminated both already.

When I examined the listed impacts of the project on fishes I was shocked at the discrepancies from those I would make. The erroneous nature of those listings has been alluded to above based on the discordance with the actual samples reported in Table II-29. To determine whether my estimate of judgment quality was realistic I set up a test with two experienced fishery biologists. These tests were run independently so that concordance of results were not due to communication among these scientists. I pointed out that two impacts - reservoir construction and channelization of the river downstream were involved and that 4 categories of change were available. Each protested about the problem of increased or decreased populations but agreed to answer in the form presented in the impact statement. Evaluations are made on 84 species (with the 2 impacts on each there are 168 estimates) and four impacts are available. Each estimate has one possibility in four of being concordant by chance, or random choices would be 42 identical responses. The actual data were 20 and 21 or less than half of the chance potential. The two individually agreed 105 times or an agreement 5 times as great as either with the impact statement. Concordance tests were run on other biologists. All 6 agreed with the impact statement evaluations less frequently than by chance. A 60% independent concordance between predictions by experts is not bad (actually it is 35% above chance) and shows that this approach is reasonable. A proper prediction is possible and would be helpful to those reviewing the draft statement. The discordances with the printed estimates are substantial and statistically significant. Both fisheries biologists independently had the same level of discordance. The parsimonious conclusion is that the evaluations in the impact statement are not discordant by chance or by lack of information. Those evaluations will misleadingly inform most readers that the impacts (+ or -) are understood.

C8

In summary it would be complimentary to report *that I believe that* this is a bad draft impact statement.

Sincerely yours,

Clark Hubbs
Professor of Zoology

CH/sjw

CITY OF TEXAS

75060

R. DAN MATKIN
MAYOR

June 24, 1976

Department of the Army
New Orleans District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

ATTENTION: Lt. Col. L.A. Hubert, Jr.
Acting District Engineer

SUBJECT: LMNPD-RE - COOPER LAKE AND CHANNELS

Dear Sir:

The City of Irving does hereby acknowledge receipt of the environmental impact statement for THE COOPER LAKE AND CHANNELS prepared by the U.S. Army District Engineer, New Orleans, Louisiana. As you know, our city is one of the three sponsors for this project.

Our engineering staff has reviewed the report and found it to be complete and concise in all respects. It is our opinion that there is nothing contained therein that should cause any modifications or alterations to THE COOPER PROJECT.

It is the recommendation of the City of Irving that THE COOPER LAKE AND CHANNELS PROJECT proceed with all deliberate haste to its ultimate completion in order that the benefits derived therefrom will not be delayed.

Yours very truly,

R. Dan Matkin
MAYOR

cc: Lewis W. Patrick

2440 Abbott Lane
Paris, Texas 75460

July 23, 1976

Col. Early J. Rush III
District Engineer
Corps of Engineers
P.O. Box 60267
New Orleans, La. 70167

Dear Sir:

We have reviewed your "Background and Summary of the Environmental Impact Statement for the Cooper Lake and Channels, Texas, Project" with more than normal interest.

I have spent a lifetime in the farming and ranching business in the Sulphur River basin and watershed with headquarters operations within 10 miles of the intersection of the North and South Sulphur main stem channels. I know first hand the problems encountered by landowners such as frequent floods that destroy roads, bridges, fences, levees, crops, improved pastures, livestock and near loss of human life. We are also interested in the proposed project's affect on the natural resources of the area of construction and innundation.

We realize that some resources such as trees, rare plants and some wildlife will be disturbed in some localities. Some habitats will be destroyed, but others will be improved or enhanced. To use this is more of a temporary disturbance and not permanent destruction. The improvement will in the long run, far outweigh the disturbance or destruction in our opinion.

We know of no landowners who are interested in growing alligator or snakes, but few if any would object to their preservation in public recreational sites or in zoos. Nevertheless, your agency is to be commended for providing barrow areas for their preservation in compliance with state and federal wildlife preservation laws.

Regardless of man made laws, however, man is the primary animal which the Creator commanded to subdue all others. The development of our land and water resources is fully justified and necessary for the survival of our society.

We hear from the ecology alarmist that our greed and carelessness are killing species of animals. We are told that about 50 species of wildlife will become extinct this century. But it is also true that 50 species became extinct last century. And the century before that. In fact, says Dr. T. H. Jukes of the University of California, some 100 million species of animal life have become extinct since the world began. Animals come, animals go, as Darwin noted, and to blame ourselves for evolution would be the height of foolishness. If man is the cause of the extinctions, he has the moral right, because he, and not alligators or snakes, is commanded to be the dominating species. To be honest, we would like to see all snakes become extinct. We are not too fond of alligators, but some people must be.

Some of our far-out environmentalists would return Texas and the Nation to their natural state by putting to an end the further development of our water resources, the improvements of flood-prone rivers and streams, and the proper management of our land resources.

It would be a disservice to Texas and our nation to attempt to curtail our industrialization, the development and management of our land and water resources. True, we want clean water, clean air, a land that is productive and free of blight. To halt or impede these would be disasterous. Lewis M. Brandcomb, director of the National Bureau of Standards said: "We cannot maintain a high living standard without continuing to increase our productivity.

This means the continued development of our water resources to provide the water we must have for our municipalities, for our industries, and for agriculture. We must continue the wise management of our soil resources so that we will have a productive soil for food and fiber; we must manage our land resources in a manner that will restore and maintain harmony between man and nature.

We should not permit the extremists, emotionalism, or any others to force us into irrational and unsound actions which can reduce progress. We must work together to insure that the resources of this nation are used wisely toward attainable goals.

The prophets of doom recall that back in the days before Texas and the nation became industrialized, our rivers and lakes were crystal clear. This is no doubt true. Those clear streams and lakes, however, were the sources of the worst cholera, yellow fever and typhoid epidemics the world has ever known. Just one of these epidemics - in 1793 - killed one of every five residents of Philadelphia.

The wet lands of the Sulphur river bottom are excellent habitat for harmful bacterial development with all the litter, sediment and debris scattered on them with each overflow or flood that occurs. And they occur frequently in the Sulphur River basin. Surely your proposed channel improvements and levee systems would relieve some of this problem.

We believe that the Cooper dam and the planned channel works are vital to the industrial development and growth of the northeast Texas area. Water resources properly developed are very beneficial to our progress and growth; uncontrolled, they are very destructive and harmful to growth and development. The undeveloped and uncontrolled waters of the Sulphur River Watershed are destroying or rendering useless thousands of acres of good land in its present undeveloped state. We cannot afford further delay in implementing this project if we are to continue the economic growth and development of our state and nation.

Sincerely,

Albert Roach

Albert Roach, Chairman
State Soil and Water Conservation Board

WHEREAS, Sulphur River runs through the County of Franklin; and

WHEREAS, the agriculture industry is a major part of the economy of Franklin County and will be benefited by the control of flooding by the Cooper Reservoir and Channels project; and

WHEREAS, the economy of several Northeast Texas counties will be beautifited by additional adequate water supply, recreation and flood control; now

THEREFORE, BE IT RESOLVED, by the Commissioners Court of Franklin County meeting in regular session on the 26th day of July, 1976, that we endorse and support the environment impact statement prepared by the U. S. Corps of Engineers, that we authorize and designate Judge W. B. Meek to present testimony in support of this statement at the hearing in Commerce, Texas on July 31, and that we urge the removal of the court injunction and the speedy completion of the Cooper Reservoir and Channels project.

READ AND ADOPTED this 26th day of July, 1976, by a vote of 5 ayes and 0 nays.

R. D. Crowston

R. D. Crowston, Commissione

Bill J. Jones

Bill J. Jones, Commissioner

Jimmie D Tosh

Jimmie Dee Tosh, Commissioner

Charles Broach

Charles Broach, Commissioner

W. B. Meek

W. B. Meek, County Judge

North Central Texas Council of Governments

P. O. Drawer COG Arlington, Tx.

July 29, 1976

Mr. David Soileau
Environmental Resources Branch
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, La. 70160

RE: 6-07-03017, Received June 14, 1976
Draft EIS - Cooper Lake and Channels

Dear Mr. Soileau:

Your Draft EIS for the above entitled project has been reviewed by the North Central Texas Council of Governments. This review included the notification of potentially affected local governments and agencies including the North Texas Municipal Water District, and the Cities of Irving, Commerce, Greenville and Hunt County. These local governments and agencies were invited to comment on the local impact of the proposal and replies received from NCTCOG's notification are attached to this letter.

In addition, the Draft EIS was reviewed for appropriate area-wide concerns. This review process included consideration by appropriate NCTCOG planning staff, by the Government Applications Review Committee on July 14 and by the NCTCOG Executive Board on July 28. On the basis of that review process, the Board adopted the following areawide position on this proposal:

> "The NCTCOG Review Process has disclosed no conflict with the review criteria of areawide comprehensive planning as outlined in OMB Circular A-95 (revised). Based on our review of the Draft EIS, it is recommended that the Cooper Lake and Channels project be constructed on the basis that NCTCOG's Regional Water Supply Plan identifies this project as an important source of additional water to serve the expanding water supply needs within the North Central Texas region."

We sincerely thank you and your staff for your kind cooperation in this matter, and if we can be of further service or assistance, please feel free to call upon us.

Sincerely,

Bill J. Pitstick

William J. Pitstick
Executive Director

pch
cc: Ron Whitehead, Grants Coordinator, City of Irving
John Waddell, Assistant General Manager, NTMWD
Mayor Thomas Young, City of Commerce

City of Commerce
1119 Alamo - Commerce, Texas 75428
Area 214 / Phone 886-2105

July 22, 1976

Mr. John Anderson
Assistant Director of Regional Services
North Central Texas Council of Governments
P. O. Drawer COG
Arlington, Texas 76011

Re: Cooper Reservoir
NCTCOG letter, dated
July 13, 1976
6-07-03017

(1) Yes, failure to complete Cooper Reservoir will have a significant impact on Commerce's projected water supply.

(2) I am definitely of the opinion that the apparent benefits of the proposed project are greater than the environmental consequences.

Yours truly,

Thomas F. Young

Thomas F. Young
Mayor, City of Commerce

TFY:wm

RECEIVED
JUL 26 1976
NORTH CEN... COUNCIL OF ...

Home of East Texas State University

TELEPHONE RESPONSE
Received July 13, 1976
From the North Texas Municipal Water District

Project No. 6-07-03017
Corps of Engineers
Cooper Lake and Channels - Draft Environmental Impact Statement

The Cooper Lake project is vital to the future water supply needs of the 11 member cities of the North Texas MWD and its additional customer cities. The approximate 1/3 share of the total project costs estimated to be borne by the North Texas MWD now exceeds the total 1968 estimated cost of the entire project. Future delays in construction will only result in higher project costs which will ultimately have to be passed on to the North Texas MWD's customers. The District's need for an additional water supply will occur prior to 1983. The earliest possible completion date of the project is 1982, so initiation of construction activity is urgently needed.

John Waddell,
Assistant General Manager
NTMWD

TELEPHONE RESPONSE
Received July 13, 1976
From the City of Irving

Project No. 6-07-03017
Corps of Engineers
Cooper Lake and Channels - Draft Environmental Impact Statement

The City of Irving strongly supports the completion of the Cooper Reservoir project. The City feels that the project will definitely be of benefit to the citizens of Irving in ensuring an adequate future water supply.

Ron Whitehead
Grants Coordinator
City of Irving
MARC Representative

SOUTHERN METHODIST UNIVERSITY
ARCHAEOLOGY RESEARCH PROGRAM
Department of Anthropology
DALLAS, TEXAS 75275

August 2, 1976

Colonel Early J. Rush III
District Engineer
U.S. Army Corps of Engineers
New Orleans District
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Rush:

We have just reviewed the archaeological section of the Draft Environmental Statement for the Cooper Lake and Channels, and we would like to direct a few remarks to the section.

On a general level, the section provides a concise overview of the prehistoric and historic settlements characteristic of the East Texas area. A cultural chronology is established, and the diagnostic elements used to define the periods within the chronological framework are well described.

On a more specific level, however, there are a number of points which are are unclear from the text, and warrant amplification.

1) A total of 283 sites have been located in the Sulphur River Basin from surveys conducted in the Cooper Lake project area, the Wright Patman Lake area, and the channeling operation area near Talco, Texas. Appendix D inventories the sites recorded for the Cooper Lake area, and the area east of Talco, but not for the Wright Patman Lake area (140 sites). Is there a specific reason for omitting this information?

2) The sites from the Talco area are supposed to be representative of the Paleo Indian through the Neo-American stages. This however, is not indicated in the site inventory (Appendix D). Dated sites in the inventory all fall into the Archaic and the Neo-American time ranges.

3) The 1974 investigation of the Arnold Site (X41HP34) by Southern Methodist University yielded a total of ten human burials, rather than nine. Osteological analysis of the skeletal material revealed that two individuals were represented at a given burial location, thereby increasing the size of the population. Nine of the burials (rather than eight) appeared to form a circular pattern in the southeastern portion of the site.

4) Section 5.05 (V-2) evaluates the probable impact of the reservoir construction on the cultural resources present in the study area. Mention is made of 90 sites within the floodpool limits, and two sites beneath the dam area. No mention is made of the 18 known sites directly adjacent to the floodpool. These too will certainly be affected, although indirectly, rather than directly by inundation. Provisions should be made for these sites as well.

5) It is felt that the summary of the investigations conducted by Southern Methodist University is incompletely represented. Appended here is a revision of that summary, giving a more comprehensive overview of research objectives and accomplishments to date. We hope this will be of use to you in revising the draft report.

As mentioned above, the archaeological section taken as a whole, is certainly satisfactory. The points itemized require some attention. The reported information should be accurate and complete, making it useful to others concerned with the archaeology of Northeast Texas.

Sincerely,

S. Alan Skinner

S. Alan Skinner
Director
Archaeology Research Program

Karen Bezsylko

Karen Doehner Bezsylko
Research Archaeologist
Cooper Lake Project

SAS/KDB:jg

Southern Methodist University Investigations Sponsored by the National Park Service

1) SMU 1970

A more extensive survey of the area was begun in 1970 by a research team from SMU. The survey produced a total of 105 prehistoric sites within and along the periphery of the reservoir project area. Surface scatters of artifacts suggested that the sites in and adjacent to the floodplain represent camps of small hunting and gathering groups subsisting on riverine and floodplain resources, while sites on the terraces and in the uplands represent activity-specific sites, such as hunting camps and quarrying stations.

While 75% of the recorded sites were located within and adjacent to the floodplain (meaning the floodplain proper, remnant knolls in the floodplain, and terrace edges), it was suggested that the prehistoric occupation of the area was to maximize the exploitation of resources of riverine and floodplain nature, with a general disregard for resources located in other environmental zones (terraces, upland edges, and uplands). However, due to the contemporary patterns of bottomland flooding during the late fall and early spring months, it was projected that continuous occupation of the floodplain sites, and a year round exploitation of the floodplain resources would have been impossible.

An explanatory settlement-subsistence model was formulated: occupation of the area was on a seasonal basis only, and prehistoric populations frequented the floodplain sites during restricted times of the year to exploit certain plant and animal resources, and relocated outside the confines of the reservoir during the remainder of the year.

After completion of the site survey, a number of sites were selected for testing to investigate their research potential. Limited testing was conducted at the following five sites: the Society Site (X41HP2), the Finley Site (X41HP30), the Jarrell Site (X41DI12), the McKinney Site (X41DI13), and X41DI59.

2) SMU 1972

The discovery of five additional sites during the 1972 field season brought the total number of known sites to 110.

A testing program was initiated to evaluate the functional variability between sites of different sizes. The four sites tested during the 1972 summer field season were the Lawson Site (X41HP7), the Cox Site (X41HP37), the Ewing Site (X41DT57), and the Thomas Site (X41DT68). It was determined on the basis of this site testing that floodplain sites were functionally equivalent, irrespective of site size.

The results of these efforts are detailed in the publication "Archaeological Research at Cooper Lake, 1970-1972" (Hyatt, Butler and Mosca 1974).

3) SMU 1973

During this season site testing was oriented to the investigation of sites located in different environmental locations. Two floodplain sites (X41HP37, and X41DT68), one site on a terrace edge (the Thalya Site, X41DT17), and a site on a remnant knoll (the Manton Miller Site, X41DT1) were selected for study. It was expected that the Miller Site might represent a permanent base camp.

The sites tested demonstrated a functional equivalence, despite their environmental locations. Floodplain and terrace edge sites differed only in the intensity of the occupation; the former being more intensively occupied. This was evidenced in particular by the density of deposits, and by the frequency of cultural features, (such as hearths, trash pits, and human burials) at floodplain sites.

Although a house structure was located at the Miller Site, the relatively shallow cultural deposit, and nature of the artifactual content suggested that this site was simply another seasonally reoccupied camp.

4) SMU 1974

A problem of systematic excavation was effected during 1974 to refine the evaluation of functional variability between sites. Special attention was given to the collection of data to clarify problems of:

a) occupation seasons
b) subsistence base
c) intrasite activity patterning
d) technological changes through time
e) surface-subsurface artifact distribution correlations
f) chronology and cultural affiliations.

A floodplain site, the Arnold Site (X41HP34) was selected for extensive excavation. The eastern half of the site was excavated, exposing ten human burials, numerous hearths, and trash pits, giving a considerable insight to the internal organization of activities within a site.

The research was simultaneously designed to continue the investigation of the relationships of terrace sites and floodplain sites.

Testing was resumed at the Thalya Site (X41DT17) to reveal a greater depth of deposit along the edge of the site than previously disclosed. A

second terrace edge site was tested (X41DT20). This site demonstrated a very shallow cultural deposit, with the usual generalized artifact inventory, suggestive of a short-term season occupation.

5) SMU 1975

The 1975 summer field season was primarily dedicated to the completion of the excavation of the Arnold Site, and the obtaining of a comparable quantity of data from a terrace edge site, the Ranger Site (X41DT19). Three additional burials were located at the Arnold Site, as well as the hearths, and three more trash pits. No features were located at the Ranger Site, despite the systematic nature of the excavation. This may be attributed to the lack of preservation in the sandy soil, or perhaps to the legitimate absence of features there, because of the very short term of the occupation. The exceptional preservation of osteological remains at the Arnold Site has enabled the determination of the prehistoric subsistence base, and has indicated that the occupation of the site may have been year-round, rather than restricted to certain seasons of the year. The sandy soil at the Ranger Site was not conducive to the preservation of osteological material, inhibiting the reconstruction of the subsistence base and the season(s) of occupation at this site.

The artifact assemblages from these two sites are of comparative value. The Ranger Site provides a late Archaic (perhaps "transitional") inventory of artifacts, while the Arnold site yields a distinct collection of Neo-American artifacts. It is expected that the comparison of thw two will clearly illustrate the technological changes which characterize the occupational periods.

Two additional sites were tested during the 1975 field season. The Luna Sites (X41DT36 and X41DT37) are located at the confluence of the South and Middle Sulphur Rivers, one on a remnant knoll, and the other at the base of the knoll in the floodplain.

The objective of testing the site on the Knoll (DT36) was to determine whether or not it represented a base camp, while the testing of the site in the floodplain (DT37) was to verify whether or not the site represented a contemporaneous and associated specialized burial area.

A total of ten test pits were distributed across the site in the floodplain (DT37). Three human burials were recovered, along with an artifact inventory suggestive of a temporary campsite, contradicting the assumption that this was a specialized burial area.

The testing of the site on the knoll (DT36) was insufficient to fully evaluate its prehistoric function. The deposit proved to be extraordinarily large (covering @ 2000 square meters) and deep (greater than 70 cms.). The seven test pits which were distributed over the site were productive in terms of artifact recovery, nonetheless inadequate to isolate the internal organi-

zation of the site, or to establish its identity as a permanent base camp.

6) SMU 1976

The synthesis of the investigations should provide a comprehensive picture of the prehistoric occupation of the area and its relationship to surrounding areas. Plans for the 1976 season (sponsored by the Corps of Engineers) include testing of 14 selected sites identified by earlier investigations. The Luna Site (X41DT36) on the knoll is among those selected. Investigation of sites in the terrace and upland zones will be stressed, as will sites pertaining to the Archaic occupation, these being relatively unexplored topics.

An evaluation of the historical cultural resources will also be done.

Based on determinations of significance, a-propriate plans may be developed for additional salvage and/or mitigation to be accomplished on resumption of construction.

9 August 1976

Colonel Early J. Rush III, District Engineer
New Orleans District, Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Rush:

The purpose of this letter is to submit a statement for the Environmental Impact Statement for the Cooper Lake and Channels, Texas, Project.

Like most of my neighbors, I support the construction of Cooper Lake. A dependable source of water is badly needed in this part of Texas. I do not, however, support the proposed channelization below the reservoir. Unfortunately, most of the residents of northeast Texas, in their enthusiasm for the reservoir, have failed to distinguish between the reservoir and the proposed plan which includes channelization. The net effect of the channelization will be to protect a few thousand acres of relatively little used river bottom land from being flooded during a "thirty year flood" --at a cost of 4.5 million dollars. In Commerce Texas alone I could point out many homes that will be flooded during the "thirty year flood", yet the proposed plan would spend 4.5 million dollars to protect this largely unihabited river bottom land. Perhaps the old phrase should be rewritten: "The maximum good for the minimum number." It should also be noted that to protect this small area it will be necessary to destroy 9,620 acres of the area that is supposedly to be protected. This area that will be destroyed harbors a large variety of wildlife. The wildlife in the remaining "protected" areas will be drastically altered since the channelized river will not provide the habitat of a free flowing river.

I hope that the channelization portion of this project will be reconsidered and dropped from the final plan.

Very truly yours,

Douglas S. Gale

Dr. Douglas S. Gale
3000 Arapaho
Commerce, Texas 75428

ark-tex council of governments
james d. goerke, executive director

August 13, 1976

Corps of Engineers
New Orleans District
Mr. L. A. Hubert, Jr.
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Mr. Hubert:

Enclosed are three (3) copies of the resolution of the Ark-Tex Council of Governments, indicating their approval of the draft environmental statement for U.S. Army Corps of Engineers Cooper Lake and Channels, Texas Project.

If we may be of any further service, please advise.

Sincerely,

Genevieve Watson

Genevieve Watson
Regional Services

Enclosures

POST OFFICE BOX 5307 / TEXARKANA, TEXAS 75501 / TELEPHONE 501 774 3481

RESOLUTION NO. 780

RESOLUTION OF THE ARK-TEX COUNCIL OF GOVERNMENTS WITH REVIEW AND COMMENT ON THE DRAFT ENVIRONMENTAL STATEMENT FOR U.S. ARMY CORPS OF ENGINEERS COOPER LAKE AND CHANNELS, TEXAS PROJECT.

WHEREAS, Section 102(2)(c) of the National Environmental Policy Act of 1969, Public Law 91-190, dated January 1, 1970, requires a detailed environmental statement relative to proposals, plans and/or projects that may significantly affect the quality of the human environment, and

WHEREAS, under Section 204 of the Demonstration Cities and Metropolitan Development Act of 1966 and Title IV of the Intergovernmental Cooperation Act of 1968, the Ark-Tex Council of Governments has been designated as the area wide agency to review certain applications and Environmental Impact Statements relative to projects for which federal financial assistance is requested, and

WHEREAS, it is desirable and in the public interest that certain development plans, and/or projects, be reviewed by the Ark-Tex Council of Governments for their consistency with the overall development of the Region, and

WHEREAS, the Cooper Lake and Channels, Texas project was authorized for construction by the Federal Flood Control Act of 1955, and

WHEREAS, implementation of the above project was halted in May 1971 by U.S. District Court due to the lack of an environmental impact statement as required by the above stated federal laws, and

WHEREAS, the U.S. Army Corps of Engineers, in June 1976, completed a draft Environmental Statement for the Cooper Lake and Channels, Texas project, and

WHEREAS, completion of the above project will economically, socially and physically benefit the Ark-Tex Council of Governments Region by increasing the supply of surface water to the western end of the region through Cooper Lake itself, by increasing the supply of surface water to the eastern end of the region through the conversion of 120,000 acre-feet of existing storage space in Wright Patman Lake from flood control to water supply, by controlling flood conditions in the Sulphur River Basin, and by increasing the supply of regional recreational facilities available to the public.

NOW, THEREFORE BE IT RESOLVED BY THE ARK-TEX COUNCIL OF GOVERNMENTS:

Section 1 - That the Cooper Lake and Channels, Texas Project, in its entirety, has been reviewed by the Board of Directors and can reasonably be expected to become a part of the overall Regional Plan.

Section 2 - That the Environmental Statement relative to the above project has been reviewed by the Board of Directors and satisfys all provisions and requirements of Section 102 of Public Law 91-190, the National Environmental Policy Act of 1969.

Cont.
Resolution 780

Section 3 - That the above project, as proposed by current U.S. Army Corps of Engineers Plans, will substantially benefit the entire region, either directly or indirectly, in the areas of economic development, water supply, flood control and recreational development, and should not be altered or changed at this point in time.

Section 4 - That the above mentioned project is desirable and urgently needed for the public safety and welfare, and should be initiated at the first opportunity.

PASSED, ADOPTED, SIGNED, AND APPROVED this fifth day of August, 1976.

Harvey A. Nelson, President
Ark-Tex Council of Governments

ATTEST:

John H. McCoy, Secretary
Ark-Tex Council of Governments

CERTIFICATION

I HEREBY CERTIFY THAT THIS IS A TRUE AND CORRECT COPY OF

☐ COG MINUTES ________ Date

☒ RESOLUTION NO. 8-5-76 Date

EXECUTIVE DIRECTOR